Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

FOREIGN AGRICULTURE REPORT NO. 9 APRIL 1944

3
763
(cop. 1)

LIBRARY
CURRENT SERIAL RECORD
JUN 24 1944
U. S. DEPARTMENT OF AGRICULTURE

The Fruit Industry of Mexico

By

Fred A. Motz
Fruit Specialist
Office of Foreign Agricultural Relations

and

Lester D. Mallory
Agricultural Attaché
American Embassy
Mexico, D. F.

OFFICE OF FOREIGN AGRICULTURAL RELATIONS
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

CONTENTS

Page

- Introduction 1
  - Size and location of Mexico 1
  - Topography 1
  - Climate and soil 3
  - The land - a problem 6
  - Transportation system 7
  - The people 9
  - Origin of fruits in Mexico 11
  - The use of fruit in Mexico 14
- The scope of the industry 15
  - Citrus fruits 18
    - Oranges 20
      - Producing regions 20
      - Varieties 34
      - Nurseries and nursery practices 38
      - Cultural practices 39
      - Grades and standards 46
      - Harvesting operations and handling 46
      - Costs of production 51
      - Prices paid to growers 52
      - Transportation 52
    - Limes 54
      - Climatic conditions 62
      - Soils 64
      - Varieties 64
      - Cultural practices 65
      - Yields 71
      - Grading and packing 71
      - Prices paid to growers 73
      - Exports 74
    - Citrus-fruit byproducts 75
      - Lime oil 75
      - Other lime products 75
      - Orange products 77
      - Future possibilities 77
  - Tropical fruits 78
    - Bananas 78
      - Commercial development 79
      - Value of production 81
      - Volume of production 81
      - Location of industry 82
      - Chiapas - leading producer 83
      - The sigatoka disease 89
      - Harvesting methods 93
      - Labor and health conditions 96
      - Costs of production 96
      - Organizations 98
      - Handling methods 99
      - Marketing 99
      - Costs of shipping and transportation 101
      - Banana byproducts 101
      - Foreign trade 103
      - Export duties and taxes 104
      - State legislation 105
    - Pineapples 106

Pineapples - continued

Page

- Development of industry 106
- Areas of production 108
- Production 109
- Farms and producers 110
- Climate 111
- Soils 112
- Varieties 113
- Cultural practices 113
- Costs of production 120
- Consumption 123
- Prices 123
- Marketing 125
- Canning industry 127
- Foreign trade 128
- Future developments 130
- Other tropical fruits 132
  - Avocados 132
  - Papayas 134
  - Mangoes 135
  - Sapotes 135
  - Cherimoyas 138
  - Sweet Granadillas 139
- Deciduous fruits 140
  - Principal producing areas 142
    - Puebla 142
    - Tezuitlán 142
    - Coahuila 143
    - Parras 145
  - Principal crops 147
    - Apples 147
    - Pears 149
    - Apricots 150
    - Peaches 150
    - Plums 150
    - Grapes 150
  - Cultural practices 151
    - Cultivation 151
    - Cover crops and intercrops 152
    - Pruning 152
    - Fertilization 153
    - Irrigation 153
    - Insect-pest and disease control 154
    - Harvesting dates and methods 154
  - Packages or containers 155
  - Production costs 155
  - Prices received by growers 156
  - Transportation facilities and charges 156
  - Cold-storage facilities and charges 156
- Mexican fruit markets and marketing methods 157
  - Mexico as a market for United States fruit 161
    - Distribution 169
    - Quarantines 171
  - The United States as a market for Mexican fruits 172
  - Restrictions on United States imports, etc. 181
- Literature cited 183

§

The Fruit Industry of Mexico

INTRODUCTION

Mexico, although our next-door neighbor, is more foreign to the average citizen of the United States than is the Continent of Europe. To many North Americans, whose most intimate contact with Mexico comes through story and legend, it is a country of romance and *mañana*, wide *sombreros*, hot *tamales*, and bullfights. Mexico, however, warrants a greater appreciation and a fuller understanding on the part of the other American people. It is a land of contrast, color, and sudden changes. From the standpoint of scenery, picturesqueness, and historical interest, it has few equals.

SIZE AND LOCATION OF MEXICO

An irregular triangle attached to the gigantic area that makes up the North American Continent, Mexico appears to be no larger than a stem protruding from a fantastically shaped fruit. The relationship of Mexico to the vastness of the area stretching from the Rio Grande to the Arctic serves to deceive one when viewing a map of the Western Hemisphere. Yet, when Mexico is cut from the map and superimposed on the territory of the United States, with Tijuana resting at San Francisco, the Yucatán Peninsula reaches all the way to Detroit, three-quarters of the distance across the United States. Placing the map of Mexico on Europe, it is surprising to learn that it will extend from Cádiz, Spain, to the southern tip of Sweden. Territorially speaking, Mexico is far from being one of the smaller nations of the world. Its land area is three and one-half times that of France, with about one-half the population.

Its long narrow shape is also deceiving. Yet, along its northern border it fronts the United States for some 1,600 miles. Tapering to the narrow Isthmus of Tehuantepec, where it is only 150 miles across, it then spreads out into a broad boot on the Peninsula of Yucatán. Mexico's shape gives it a tremendously long coast line, and one generally thinks of it as lying mostly north and south. When one follows an imaginary line from Tijuana to the tip of Yucatán, however, he readily sees that the country lies more to the east and west and is surprised to learn that sections of the Yucatán Peninsula are east of Pensacola, Florida.

TOPOGRAPHY

The outstanding features of Mexican geography are its vast tablelands that are broken up by extensive mountain chains, some peaks of which reach remarkable heights. The Sierra Madre Occidental extends from the Mexico-Arizona border southward along the Pacific coast almost to the Isthmus of Tehuantepec. Near Tehuantepec this range mingles with the Sierra Madre Oriental, a rugged continuation of the Rocky Mountain chain, which roughly parallels the east coast south from Texas. It contains Orizaba, the

Grateful acknowledgment is made to Douglas M. Crawford, Office of the Agricultural Attaché, American Embassy, Mexico City, for his valuable assistance in bringing together statistical data and in conducting a field survey and contributing the sections dealing with pineapples and bananas. The authors also wish to express their appreciation for the generous assistance and cooperation of the officials of the Ministry of Agriculture and Development of Mexico, particularly that of Ing. Eduardo Morillo Safa and Ing. Salvador Sánchez Colín; also the growers, processors, distributors, importers, and others who contributed to the information contained in the report. The writers are also indebted to members of the Office of Foreign Agricultural Relations, who gave much of their time and assistance in preparing the data for presentation to the public.

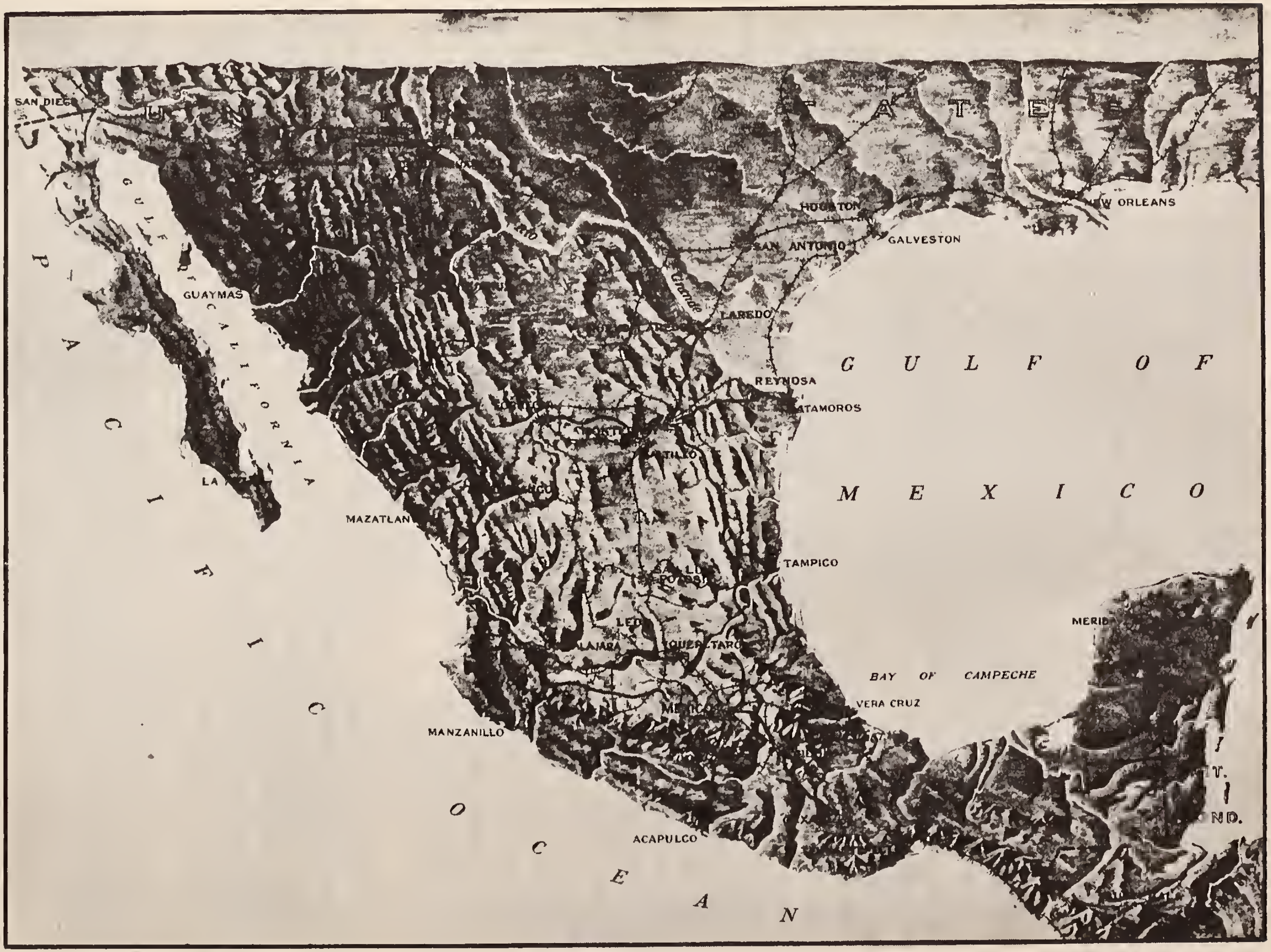


FIGURE 1.-Relief map of Mexico, showing the rugged topography of the country and the principal railroads and highways.

second highest peak in North America. Mountains again begin to rise in Chiapas and become the highland country of Guatemala. There are, in addition, many cross ridges which serve as barriers to isolate one part of the country from another. In Mexico one cannot travel between two important points or cities without crossing at least one range of mountains.

More than half the country lies 3,000 feet above sea level, and only a third may be called more or less level.

A vast tableland lies between the two main northern mountain ranges. The *mesas* which make it up are divided into three broad parts, the northern about 3,000 feet above sea level, the central about 7,000, and the southern about 6,000. Between the mountain ranges and the sea lie the coastal plains, mostly known as the *Tierra Caliente* or "hot country."

While Mexico is a large country in terms of land area, its profile is so broken and portions are so dry that only a small part is at present suitable for agricultural purposes. Estimates as to the amount of cropland vary from less than 7 percent to 11 percent of the total area. Were an accurate census possible, it would likely approach the larger figure. In addition, an agricultural observer is struck by the amount of land that apparently could still be put under cultivation. No one solution to the problem of utilizing this land to better advantage appears. Yet a number of steps could be taken toward this objective. Above all, more adequate communications would help. In some areas, the adoption of dry-farming techniques would permit the cultivation of crops; in others of heavy rainfall, education and the improvement of health conditions are needed. The amount of good land is limited, but one should note that much of the problem of utilizing available land resources involves demographic aspects and is social rather than physical.

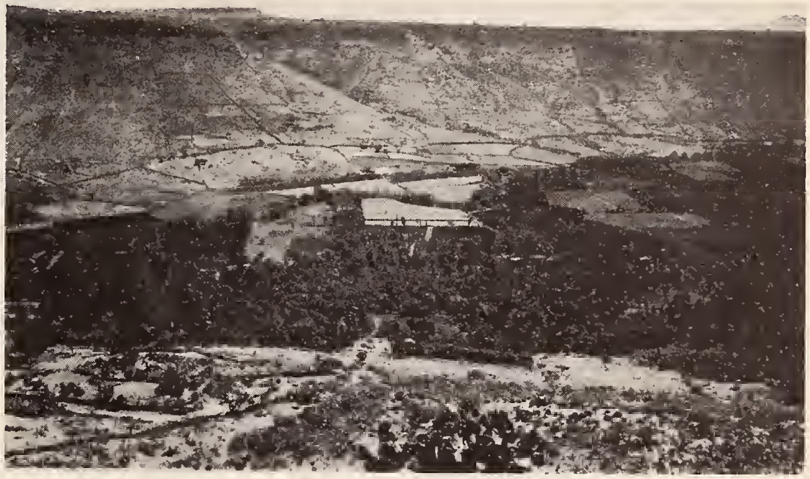
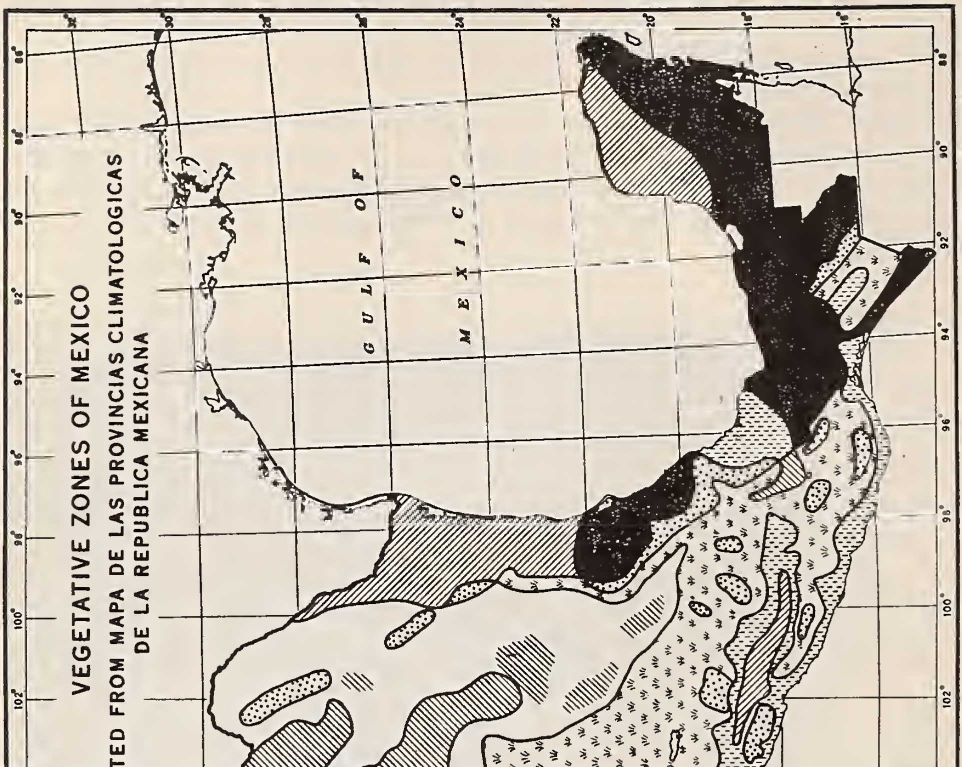


FIGURE 2.-Fruit growing in the sheltered Valley of Atotonilco in Jalisco.

CLIMATE AND SOIL

The complex picture of climate in Mexico has high lights and shadows. Many regions are involved, often with quite special patterns. To explain it briefly is to lose much fact in oversimplification, but space does not permit an extended discussion. A few generalizations may aid in understanding conditions. Reference is made especially to the schematic map (see fig. 3) showing the vegetative zones of the country. Rainfall varies tremendously, even at relatively nearby points. The extent of rains in various parts of the country is fairly well shown by the dominant vegetative types on the map and may be related as follows: Tropical forest and selva, humid to very


VEGETATIVE ZONES OF MEXICO
ADAPTED FROM MAPA DE LAS PROVINCIAS CLIMATOLOGICAS DE LA REPUBLICA MEXICANA
GULF OF MEXICO
PACIFIC OCEAN
▨ Spiny chaparral
▨ Desert type (organ cactus, nopal, maguey)
Subalpine
☐ Steppe
Semisteppe
Savanna
■ Tropical forest and selva
116°
114°
112°
110°
108°
106°
104°
102°
100°
98°
96°
94°
92°
90°
88°
86°
32°
30°
28°
26°
24°
22°
20°
18°
16°

U. S. DEPARTMENT OF AGRICULTURE

NEG. 138 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 3.-Map of Mexico showing vegetative zones.

humid; savanna, or tropical prairies of tall grass, semihumid; semisteppe, tall and short grass, semidry; steppe, short grass, dry; spiny chaparral, dry or at least a long dry season; desert, very dry.

Rainfall in Mexico has a definite periodicity and different periods for the various zones. In the States of Tabasco and Yucatán and on the northeast coast the intra-annual periods are not well defined. West of this zone and south of the Tropic of Cancer the winter is the dry season extending from October to April. Northwest Mexico has its driest period in the spring.

Temperature variations are not so well defined as those of rainfall, but in a broad way south of the Tropic of Cancer no such demarcation exists between seasons as are found in the United States or Canada, and winters are not so definite. North of the Tropic of Cancer winters, while definitely marked, are generally mild.

From arid desert to tropical jungle every range of climatic condition is to be found. Constant change in climate results especially from variations in elevation and the lay of the mountains and hills. Unlike most countries where one zone gradually tapers off from another, in Mexico the breaks are sharp and come without warning. A turn of the road more often than not presents to view an entirely different scene. In relatively few miles one may go from banana plantations to pine forests. Nearly every situation and every climate for fruits are found, and most kinds are grown. Dominant types are those native to Central America and to Europe.

The climate is naturally conducive to perfection in case of most native fruits and proves very good for subtropical types, such as citrus, especially oranges and limes. It leaves something to be desired, however, for the Temperate Zone fruits. Bananas in Tabasco, pineapples on the Isthmus, mangoes in Veracruz, and limes all over the warmer southern areas flourish in abundance. Sapotes, mameys, custard apples (cherimoyas), and others are, of course, at home. Apples, pears, cherries, peaches, apricots, and plums, while produced commercially, do not thrive so well as in the more northern latitudes. In spite of higher altitudes with coolish winters, suitable frost-free periods, and other factors, the quality of the deciduous fruits now grown leaves a good deal to be desired. Part of this is no doubt due to heavy summer rains and their consequent effects. As may be conjectured, however, other and more important factors are present, such as the choice of varieties and the lack of approved cultural practices. All the older varieties are somewhat degenerate progenies of Spanish fruits introduced 400 years ago; and, since unimproved, they are for the most part seedlings. They lack quality from nearly every standpoint. The newer varieties have almost without exception been brought in from the United States; many were originally of European parentage or origin. The popularity of fruit from the United States is generally evident. The fact, however, that an apple or pear may do well at one latitude and be of poor quality in another is too well known to require comment. That the apple largely chosen for transplanting into Mexico was the Delicious is perhaps unfortunate, for this variety reaches its apogee at about latitude 48° N. Plum trees imported were mostly varieties that do best in Central California and similar regions. That proper breeding and selection would result in fruits more adaptable to the different schedule of light units and the different intensity of the dormant period appears not only entirely possible, but also probable. As far as climate alone is concerned, a suitable kind exists for practically every fruit, with one exception. For subtropical and Temperate Zone fruits, moisture, either as rain or irrigation water, is often insufficient for optimum conditions or large-scale production.

The chief soil types of Mexico are those one would expect to find in view of its topography. A climatic map of Mexico would closely resemble the pattern of vegetative zones illustrated (fig. 3) and, broadly speaking, soils follow these too. The hot, low, and humid areas have a tropic-forest soil; the pine forests, their characteristic type; and the desert, its predominantly limestone sandy formation. The picture is, of course, varied and complex; because of the extensive systems of mountain ranges, much of the soil is of volcanic origin; the remains of old lakes, or the action of former seas, are much in evidence.

Wide observation of the soils, where fruit is now grown, shows there is no lack of suitable soil. Other extensive areas are also available. It is true that one finds orchards where lack of fertility is quite evident, but such condition is less attributable to geological factors than to a steady, assiduous single-cropping for hundreds of years past. From rich, friable, silt loams to heavy adobe clays the range is ample for all fruits from peaches to limes.

Insofar as the production of fruit is concerned, an ample variety of lands, with suitable soil and climate, exists to supply all the fruit Mexico may consume and an exportable surplus as well. The physical features of the country, while rugged, do not necessarily prevent an adequate development of the industry.

THE LAND - A PROBLEM

Of all the countries of the Western Hemisphere, Mexico has created the greatest interest and attracted the most attention through its efforts to rearrange the land system. With a population of 19,653,552 persons, according to preliminary data of the census of 1940, there were 10 persons per square kilometer (25.9 per square mile). According to the International Year Book of Agricultural Statistics, 1937-38, the figures for 1936 in other countries were as follows: United States 16.4 (42.5), France 76.1 (197.1), Netherlands 245.1 (634.8), Argentina 4.5 (11.6), and Chile 6.1 (15.8). Population in Mexico between the census periods 1930 and 1940 increased by 18 percent and will probably continue to rise. Land requirements for food production will likewise increase. Part of the latter can be taken care of by new irrigation works now being constructed, part by better farming, and part by the opening up of new land. But unless a better farming technique is adopted and some undeveloped resources greatly utilized, the time is probably not far off when population pressure on the land will be keenly felt. This situation may become one of first magnitude, but land problems are nothing new in Mexico. Land has been one of the basic causes of the wars and revolutions that have swept across the country throughout history - not how much land, but who had it. To understand the present situation, brief reference will be made to the past.

Before European conquerors moved in to disrupt well-established customs, land was no problem. Generally the Indians farmed for their family needs on individual parcels, but the land was held in common by the village. The Spaniards were not long in attempting to set up for their own use and profit considerable landholdings - usually by taking the land from its local inhabitants.

With many ups and downs, holdings of great size were acquired by private individuals and by the Church. About 1850 the Church owned over one-half the national territory. The situation became most acute, however, in relatively recent times. At the end of the Díaz epoch concentration in Mexico exceeded that in any other Latin American country, with less than 10 percent of the population owning land. The general system was that of the *hacienda* - a self-contained, almost self-governed, selfsufficient unit, on which practically all the needs for livelihood were raised or produced. The haciendas tended to be feudalistic, and many reached the size of small kingdoms. Unlike Chile, where landholding also reached great heights, but where the owners lived on their lands, Mexican *hacendados* often had a house in Mexico City and spent a good deal of their time in European travel. Concentration of holdings, feudalistic treatment of those who tilled the soil, and absentee landlordism combined to form an admittedly bad system.

The revolution of 1910-20 initiated many changes, but most of them did not become effective until during the past 10 years. The result has been the transition of Mexico from a country of large holdings to one of small farms. During the 20 years that the land program was under way and prior to the advent of Cárdenas, some 20,000,000 acres were turned over to the peasants. During his presidency (1934-40), according to estimates, more than double that amount, or about 47,000,000 acres, were partitioned. This land was distributed in the form of *ejidos*, or grants, to villages with certain restrictions as to usage and administration.

The ejido, oddly enough, is the oldest, yet the newest form of land tenure in Mexico. Its origin can be traced back to pre-Spanish days, when the Aztecs were the overlords of Mexico. At that time land was held by the *calpulli*, or clan. Privately owned lands existed, but the predominant system was a type of communism with the soil held in common by the community and assigned for use to families.

The program undertaken by the Government of Mexico has been an attempt to return, in part, to this system of land tenure. Under all grants to villages, the ejidos, although titles and rights of use are given to individuals, except in cases where collective exploitation seems more advisable, the land cannot be alienated and reverts to the community if not used.

Another generation must pass before the new system will be well integrated and functioning smoothly. Many problems remain, most of which will probably be solved with the passage of time.

Land division is now nearly completed for the simple reason that few large holdings remain. Many people still desire land, but in a vast number of instances small units are uneconomic. Possible future trends, however, may be toward individual ownership of small parcels. With a developing pressure of population, a great expansion in research and education will be vital. Although neglected during the reform period, such work has now been started in a small way. Force of circumstances should, in a few years' time, engender greater government attention to the improvement of farm practices.

TRANSPORTATION SYSTEM

Because of the mountainous character of Mexico, as well as its extreme length, transportation within the country has always presented a difficult problem. Travel up and down the central plateau has been relatively easy, but to go east or west from the middle of Mexico is another story. One has to ascend mountain ranges of great height and cross over passes that average about 10,000 feet. Not too many years ago a trip over these mountains was considered a real undertaking.

The consequent difficulties of travel have made for the virtual isolation of various sections of the country. Partly for this reason, Indian tribes still exist that have not yet adopted the Spanish language but continue to use their native tongue. The lack of communication has left parts of the country unexploited, and portions of the States of Chiapas and Campeche still remain practically unknown.

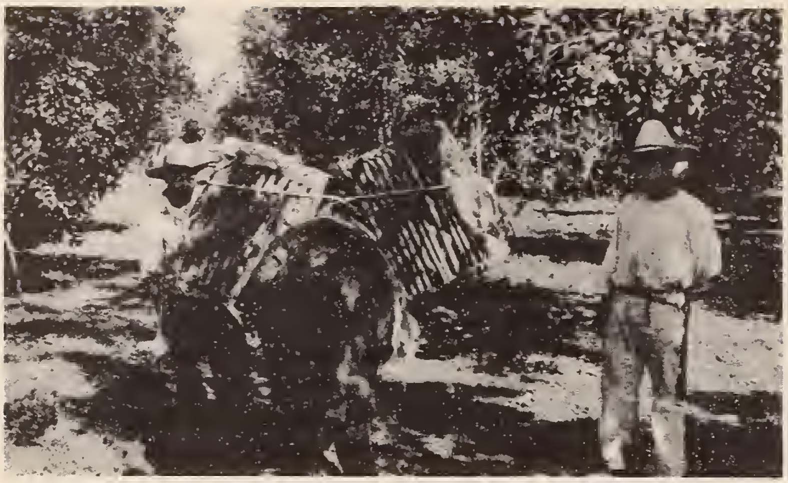


FIGURE 4.-Transporting system used in orchards near Jalapa, Veracruz. The home-made crates are filled on the ground, then covered with burlap sacking, and slung in pairs onto the backs of horses or mules for transport to road and truck.

Only about 50 years have elapsed since Mexico began to develop its transportation systems in earnest. Real progress was made, however, during the long presidency of Porfirio Díaz (1877 - 1911), when railway mileage was expanded from a few hundred miles to 14,000. A railway was first constructed within the country in 1850. It was a short line running from Mexico City out to Guadalupe, the most famous shrine in the country. The first railroad of importance was not constructed, however, until 1874. A line was put through from Veracruz, the first port of Mexico, to the central plateau by a British concern. It is still in operation today and is the only important electric railway in the country.

Three main lines now leave Mexico on the northern frontier. These reach the border at Nogales, in the west; El Paso, approximately in the middle; and at Laredo, in the northeast. The lines from El Paso and Laredo carry the bulk of the traffic. A network of trunk lines runs among these main arteries, and relatively speaking the portion of the country north of Mexico City is fairly well supplied with railway communications. A different situation exists, however, in some other parts of the Republic.

From Mexico City to Veracruz two important railways are in operation, one of which, as mentioned previously, was the first railway of any length within the country. From Veracruz down to Guatemala a line follows the Gulf coast to the Isthmus of Tehuantepec; it then crosses to the Pacific side and continues down to Guatemala.

Although the central plateau is also fairly well supplied with railways, the coast south of Manzanillo to Salina Cruz has nothing in the way of land transportation, except for a few miles of road near Acapulco. All shipments to and from this section have been made by water, which offered a more convenient and natural route. The Yucatán Peninsula has no means of overland transportation to and from the rest of the country. In ordinary times, when ample ocean-shipping space is available, the need for a road or railroad there does not make itself so apparent; but when water transportation grows scarce, as in time of war, the lack of overland communication is severely felt.

Probably the railroad has meant more to Mexico than to most other countries. Long stretches of highways were practically unknown 10 years ago, and only recently, since 1930, have they begun to supplement the railroad and push their way into new territory. The famous Pan American Highway to Mexico City was not completed until the middle of the presidency of Cárdenas. Since then highways have been extended to Veracruz, on the Gulf; Acapulco on the Pacific; and Guadalajara, Mexico's second city in the West. The new road from Mexico City to Oaxaca is nearing completion. Earlier road connections were established between Laredo and Monterrey and from Monterrey to Saltillo. Many more highways are needed before the country has an adequate transportation system, particularly for getting fruits to market. Railroads are slow and tractive power and rolling stock scarce. Refrigerator cars especially are in very short supply. Truck shipment of oranges from Nuevo León over the Pan American Highway, and from Veracruz State over paved roads to Mexico City has increased markedly in recent years. Off the paved road, the fruit takes a severe beating on its way to the consumer. Future development of fruit growing will be limited in part by available transportation facilities. Growing areas are therefore expected to expand and multiply along present main arteries.

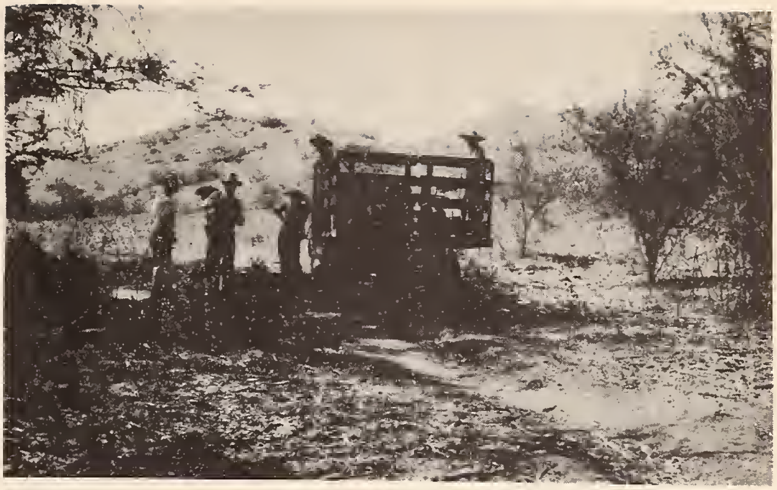


FIGURE 5.–Truck used for transporting fruit.

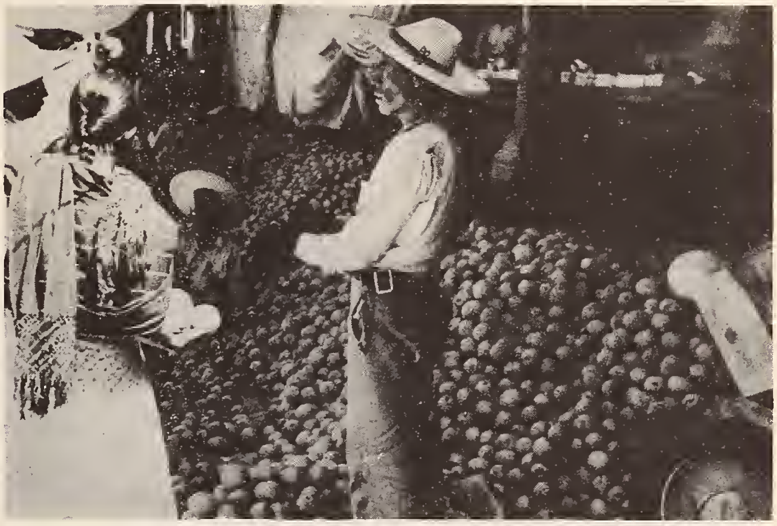


FIGURE 6.-The local market place at Apatzingán, Michoacán.

THE PEOPLE

Although the vast majority of Mexicans speak Spanish, they are by no means racially pure descendants of the original conquerors. On the contrary, Mexico is not a Latin country from a racial standpoint, but Indian, since about 90 percent of the people have some Indian blood.

To state with accuracy the exact blood mixture of the Mexican people is almost impossible. A number of estimates have been made in this connection, and there is considerable disagreement as to the various percentages. Only a small percentage of the population is white, and Mexicans together with many of their Latin American neighbors are proud of the fact that a majority of their people are descendants of the native Indian tribes or races which, before the coming of the Spanish, developed in these countries high types of civilization.

Mexico has never had a large number of immigrants. Instead the trend has rather been in the other direction, with many Mexicans emigrating to other lands, particularly to the United States. That only some 300,000 registered immigrants left Spain for Mexico during the colonial period (1521-1800) is hard to believe. This number compares with nearly a million foreigners a year who migrated to the United States at the close of the nineteenth century. Since 1800 the foreign element in Mexico has increased but little. A number of Italians were brought into the country during the Díaz regime, but most of them later returned to their native lands or went elsewhere. In recent years Spanish refugees have come in, but many of them look upon Mexico as only a temporary abode.

At the turn of 1800 and just before the Wars of Independence, Mexico was estimated to have a population of only 5,800,000. During the whole of the nineteenth century it did little more than double itself. In 1910 the population was 15,160,369, according to the Mexican census. After a little more than a decade of civil strife the population dropped to 14,444,434 in 1922. Since that time, however, the increase has been rapid. The 1930 census showed 16,552,722 and by 1940 the population had reached 19,653,552.

A vast difference exists between rural Mexico and Mexico of the larger cities. The contrast is as marked as that between night and day, or almost as great as that between two separate lands. The newer streamlined suburbs of the capital with their Spanish homes remind one of the better residential districts of Southern California. The architecture of the recent office buildings is ultramodern, and in Mexico City a great building program is going on, changing the former city of colonial buildings to one apparently lifted from a recent architectural journal. Yet, at the same time, rural Mexico continues much the same as it was before the coming of the Spaniards. The Indians sleep on dirt floors on woven mats called *petates*. Corn continues to be ground by hand on the same type of inclined stone made of a kind of volcanic rock. A small stone mortar is in general use for the grinding of chili and tomatoes to make the much-used chili sauce. A good deal of the rural transportation is by humans, or by burros who are guided by an Indian shod in *huaraches*, a type of leather sandal with, more often than not, pieces of old tire serving for soles.

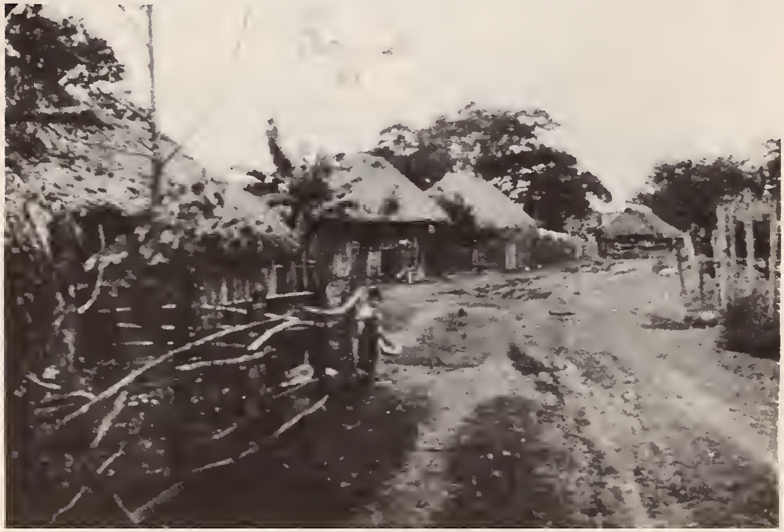


FIGURE 7.-A rural scene in tropical Mexico.

The culture of the rural districts reflects a strong native influence. The country has the Spanish language, the Catholic religion, and a Spanish courtesy. Its farming practice is in great measure still according to tradition. Such tradition has served the country mightily. The basic corn patch and beans have been planted year after year, regardless of adversity or upheaval. In modern times it is a deterrent, since any change in practice, involving any thought of conservation, any long-term crop, or provision for the morrow, is difficult indeed. This has a marked significance in the fruit industry. Most horticultural tree crops require years of care before they come into production, insects and diseases must be dealt with, and finally the fruit must be carefully handled and carried to market. Such practices do not fit into the average rural philosophy of Mexico. Hence the new expansion, especially in oranges, is on the basis of fair-sized plantings, arranged for by some villager, or city dweller. Often he has no connection with or knowledge of agriculture but is becoming a side-line farmer because he has money to invest in what appears to be a sound financial risk. Under such conditions favorable markets tend to stimulate much planting activity, whereas unfavorable markets are likely to result in subsequent abandonment and increased problems of disease and insect control.

ORIGIN OF FRUITS IN MEXICO

The Conquest of the New World has invariably been associated with the quest by the early explorers for precious metals and other riches. Undoubtedly this served as one of the principal motivating forces behind Cortez's expedition. Many of his followers were greedy to accumulate quick fortunes. This fact is well substantiated, for when Cortez beat a hasty retreat from Mexico City a number of his men fell victim to the Aztecs because the weight of gold and other riches carried on their persons did not make for ease of movement, nor did it aid them in crossing the canals that surrounded the city.

Yet from the outset the Crown in Spain and other groups gave considerable time and energy to the development of other phases of colonial life, one of the most important of which was agriculture. Interchange of plants and trees between the New and Old Worlds went forward at a much faster rate than most people imagine. In most instances one cannot state with accuracy the exact date on which a certain type of tree or plant was first introduced into Mexico. From data gathered from some of the historians, reports of missionaries, and the accounts of early travelers, such a date can, however, be approximated.

Considerable interest was manifested in agriculture soon after the coming of the Spaniards in 1521. While many of the commodities exported from Spain were heavily taxed, agricultural products were among the few that came through duty free. By a Royal Decree of June 1523, the Casa de Contratación of Seville, the clearing agency for the Spanish colonies in the Americas, was directed to arrange for the sending of skilled artisans and farm laborers to Mexico. By this same decree quantities of plants, seeds, and trees were also sent for planting.

Cortez can be given the credit for the introduction of some of those agricultural plants and seeds, but one must remember that he fell from authority shortly after the Conquest. Other leaders were sent from Spain to replace him. They carried on this work to some degree, but the people really responsible for the widespread introduction and dissemination of agricultural products were the missionaries who began to arrive in Mexico in 1524, 3 years after the Spaniards entered Mexico City. The first to come were the Franciscans, who apparently, from an agricultural point of view, contributed more than any of the others. Then came the Carmelites and the Dominicans, who also aided in this phase of work. They were followed considerably later by the Jesuits, who did much to spread agricultural knowledge throughout northwestern Mexico.

By 1550 practically all the Old World crops produced in Spain and Portugal had been carried to Mexico and were being cultivated, some of them in extensive plots. A number of plants were brought to the Antilles from the Iberian Peninsula before 1500, and some of these were later carried to the mainland for propagation. All of this was over half a century before the first English settlements were made in what is the present-day United States.

The comments made by Father Alonso Ponce, Commissary of the Franciscan Order, who made a tour of the various missions about 1585, are interesting (*6*).[1] He noticed, "such Castilian fruits as oranges, lemons, walnuts, apples, quinces, several varieties of peaches, plums, apricots, pears and cherries," as well as, "a great assortment of vegetables, black grapes, olives, and plantains."

An investigation of all the crops would be interesting, but efforts have been limited to determining approximately when certain varieties of fruit trees and seeds were first introduced into New Spain. From a background study European fruits appear to have been growing in Mexico for about four centuries, and a number of orchards were probably in production long before the first Pilgrim landed at Plymouth Rock.

The Spaniards introduced citrus fruits into Mexico within the first decade after the fall of the Aztec Empire. One of the followers of Cortez, Bernal Díaz del Castillo, kept a running account of his version of the Conquest of Mexico. He states that he was the first person to plant oranges in this country, although it was only by chance. He made a trip with the Spanish explorer, Grijalva, in 1518, when the latter landed on the coast of Mexico in what is today the State of Tabasco. His account of the incident is the following (*1*):

> . . . as this country is infested by mosquitos, in order to avoid them I went to sleep in a large temple, near which at this time I sowed seven or eight seeds of oranges which I had brought from Cuba. They grew very well, for the priests of the temple took care of them when they saw that they were uncommon plants. This I mention because they were the first trees of the kind that ever grew in New Spain. After the Conquest of Mexico, this province being considered as offering the greatest advantages, was chosen by most of the principal persons amongst the conquerors, of which I was one and on my arrival there I went in search of, and found my young trees flourishing and having transplanted them they all did very well.

Limes are widespread in Mexico and in common use among the people. Their origin is still the subject of debate. Many believe they were indigenous to the islands of the Caribbean. Whether they also occurred naturally in Mexico is not yet known. They grow wild in the forests along the east coast and quite possibly they have been growing there for ages. Some evidence points to this conclusion in Central America, especially since limes are found along river banks and the paths of old settlements. Whether they were also brought into Mexico and widely scattered – the opinion of some – is conjectural.

Others hold that limes were introduced into the New World from Spain, because citrus fruits arrived in Western Europe from Asia about the beginning of the fourteenth century. Columbus, however, on one of his voyages reported that he found "lemons" and oranges growing on the islands of the Caribbean. Also, Baron von Humboldt, the famous German scientist and historian, who made an extensive survey of the country in the early 1800's states that a small lime, about the size of an almond, was a native of the country (*3*). In any case, limes were commonly known in Mexico during the sixteenth century.

A type of native plum, called "hog plum" in English, and scientifically termed *Spondias mexicana*, was found growing in many parts of Mexico when the Spaniards arrived. Generally the plant is not much more than a shrub. The fruit is small, yellowish in color, and has an acid taste. Substantial quantities of this fruit are still eaten by the Indians in the rural districts. Often the fruit is used to make an intoxicating liquor. One of the Spanish conquerors makes the following observance (7): ". . . wine they make from the fruit is of fair quality and keeps a year; to me it appears better than the apple cider of Vizcaya."

---

[1] Italic numbers in parentheses refer to Literature Cited, pp. 183-184.

Records show that European plums were planted at Huejotzingo, one of the principal missions of the Franciscans and located not far from Puebla, as early as 1530. This region continues to be an important producing area for plums, apples, pears, and peaches.

Apples were among the first fruits brought to Mexico. The belief is that they were originally planted in the Republic in 1522 by Gregorio López, who started a small orchard in Jalisco.

The spread of deciduous fruits was greatly aided by the Indians. As one travels around the rural sections of Mexico, he finds small plots of apples and plums growing apart from any present village. Possibly these trees mark the resting places of nomadic tribes who were instrumental in carrying seeds from Mexico to the United States. In this connection, the comments made by V. Havard (2), who wrote about the food habits of the American Indians at the close of the nineteenth century, are of interest:

> The Indians certainly exhibited commendable promptness and industry, after the advent of the whites, in introducing such fruits as were shown to be desirable. Thus, the Peach brought into Mexico soon after the conquest was, according to the testimony of Du Pratz, found in general cultivation among the Indians of Louisiana when the French settled the province in 1698, and had become abundant in Georgia . . . in 1723. Wm. Bartram describes the carefully planted Orange groves of the Indians which he noticed in 1773. The early introduction and propagation of these two plants by the Indians led to the erroneous impression that they were of American origin.

Of all the fruits introduced from Spain into Mexico, grapes were the earliest to be developed on a real commercial basis. The first cultivated grapes were the species of *Vitis vinifera* L., or European grape. Cortez is said to have ordered his followers to plant a number of acres of grapes.

In the colonial period the cultivation of grapes spread rapidly, and they were chiefly used for wine making. When the New World Colonies, particularly in Mexico and Chile, began to compete with the Spanish industry, a blanket order was issued for the cessation of wine making. Thousands of acres of vineyards were removed, and for a number of years this once-thriving industry was at a standstill. Control of commerce was a monopoly enjoyed by the merchants of Spain, and the Spanish Colonies were expected to work within this scheme for the benefit of home industry.

A number of varieties of native grapes are grown in Mexico, but the fruit was not generally consumed as such. Instead the Indians employed the vines in basket making and used the fruit to make a type of purple dye.

Early Spanish chroniclers mention finding cherries. What they undoubtedly referred to was the *prunus capuli*, a fruit resembling the black Tartarian cherry, but a good deal smaller and of a different flavor. It was a well-known fruit in the market places before the Conquest and is still quite heavily consumed by the lower classes. The venerable Bernal Diaz del Castillo explains that during the fight for Mexico City (7), "corn we had sufficiency of, but we wanted refreshment for the wounded. What preserved us was what the natives called 'quiltes' [he probably did not get the Indian sound of *calpuli* correctly], cherries while in season."

Fig trees were brought to Mexico at an early date, probably about 1535. The Spaniards, however, had already found a type of fig tree growing in Mexico. Apparently the fruit was not eaten, but the bark provided the Aztecs with their main source of paper. This paper was used for many of the manuscripts and codices that today give a key to the Indian way of life. They may still be seen in museums.

Standley, who has investigated Mexican flora a good deal, explains that the word "amate," a take-off on the Aztec "amatl," is sometimes still employed for fig in the rural districts instead of the Spanish word "higo." For example, there are Amatepec, "hill of figs," and Amatitlan, "among the fig trees."

Generally, the Portuguese are supposed to have introduced the mango into the Americas. The first tree is believed to have been started at Bahia, Brazil. From there, about 1742, it found its way to the West Indies. Early in the nineteenth century it was introduced into Mexico by Juan Antonio Gómez de Córdoba.

Yet this date seems to be rather late. One must recall that the Spaniards began regular trips from Acapulco to Manila as early as 1565. The Malay Peninsula and Asia are known as the original home of the mango. Throughout the colonial period, or for over 225 years, commerce was carried on between Mexico and the Philippines. All manner of precious metals, silks, spices, and other commodities, including plants, were brought from the Far East. Therefore, the mango was probably introduced almost two centuries before 1800. The fact that the "Manila" mango is found growing much more extensively on the eastern coast, than on the western, does not necessarily mean it was introduced into Mexico from the Gulf side. On the contrary, it might well have come directly from the Far East. Acapulco, on the Pacific, served primarily as a clearance port, and cargoes were brought directly to Mexico City by muleback. There the authorities determined what quantity of a shipment was to go to Spain, and what items were to remain in the country. Since the west coast, especially the State of Guerrero, was largely unsettled and the east coast in the State of Veracruz was far more populated, with large haciendas the rule, plants and seeds for planting were probably distributed among the hacendados in this region.

Where the cherimoya (*Annona cherimola*), or custard apple, originated is not exactly certain. The general belief is that it came from some part of Ecuador or Peru. Its name is of Quechuan origin and a number of vases modeled after a cherimoya have been dug up in the highlands of Peru. More than that cherimoya comes from the Quechuan word meaning cold seed. This plant was thriving in Mexico when the Spaniards arrived.

Sapotes and guavas probably originated in the lower regions of tropical Central America. According to the early Spanish writers, pineapples grew wild in the tropical lowlands of Mexico. The Indian name for this fruit was "matzatli." When the Spaniards arrived in the Antilles they found the pineapple growing there, and it was called "anana" by the Cariban Indians - a name still used by the French.

THE USE OF FRUIT IN MEXICO

Just how much fruit is consumed in Mexico cannot be determined, but the quantity is undoubtedly large. Geography, climate, and transportation play a considerable role in the supply. Probably the best supplied area is in the middle climatic zone; that is, from 3,000 to 6,000 feet in elevation, for more varieties are grown there, and apparently a greater desire exists for fruit. The central plateau as a whole is not well supplied, and even parts of the tropics are short, more for lack of human willingness than for climatic reasons. On the whole, however, the diet of the people contains fruit, and the market places of Mexico normally have a striking array of fruits for consumption. The great variety of fruits maturing at different times assures vitamins and acids to the people. Even in the poorest dry sections, the cactus pear is found; and at times, when other foodstuffs grow scarce, it is heavily utilized.

Increased production and consumption of fruits appear to depend less on growing possibilities than on income levels, transportation, and habits of the people. Cheap fruits are eaten in good quantity. As marketing facilities improve, more will undoubtedly be used. Oranges form a striking example. Consumption has risen rapidly, and in season they are to be found in small market places, far from the centers of production. Orange consumption may well double in the next 5 years.

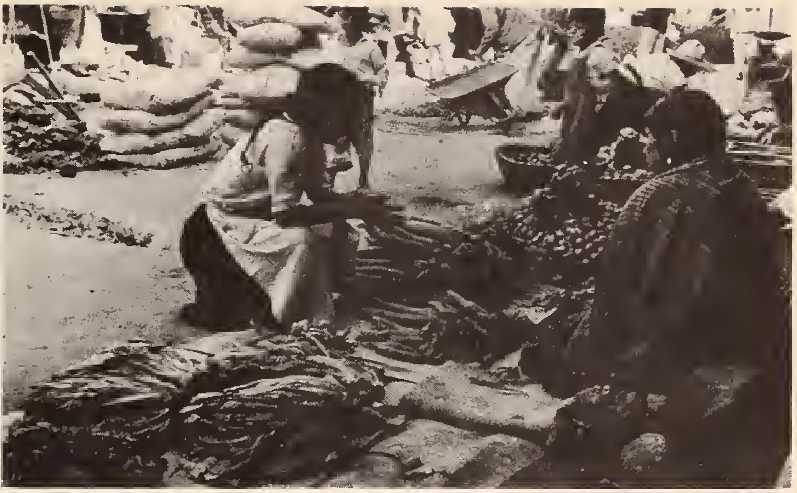


FIGURE 8.-Fruit stand where buyer and seller meet, Córdoba, Veracruz.

However, the integration and building up of more efficient marketing facilities and low-cost transportation will be a slow job, and, with the customs of the people as outlined above, fruit growing is unlikely to become a prime industry in Mexico. Developing a product that will satisfy export-market requirements is difficult. For pineapples and bananas, which reach export presentation in the field, the problem is less difficult. On the other hand, for a crop such as oranges, which require careful selection, packing, and handling, the probable excess production of a few years hence may fall far short of realizing certain expectations with regard to overseas markets.

An excellent step in developing the fruit industry and in building up the productive capacity and income of the people as derived from this industry would be its stimulation through the granting of tax exemptions. For instance, a decrease of the export duty could not fail to assist an industry that is in the throes of development. A number of possibilities exist for developing large markets for fruits abroad, especially in the United States. Such opportunities depend primarily upon the offering of standardized articles at reasonable prices in order to develop usage and widespread market demand. A few fruits for which a much greater demand could be stimulated include limes, fresh pineapples, bananas, and papayas.

THE SCOPE OF THE INDUSTRY

The fruit industry of Mexico, when compared with that of other large commercial fruit-growing countries, such as the United States, Australia, South Africa, Spain, Argentina, Brazil, and Palestine, does not appear important; but in terms of population, amount of arable land, transportation, and other factors, the total amount of all fruits produced looms large. Because of the geography of the country, diversity in climatic conditions, poor communications, and the wide variety of fruits produced,

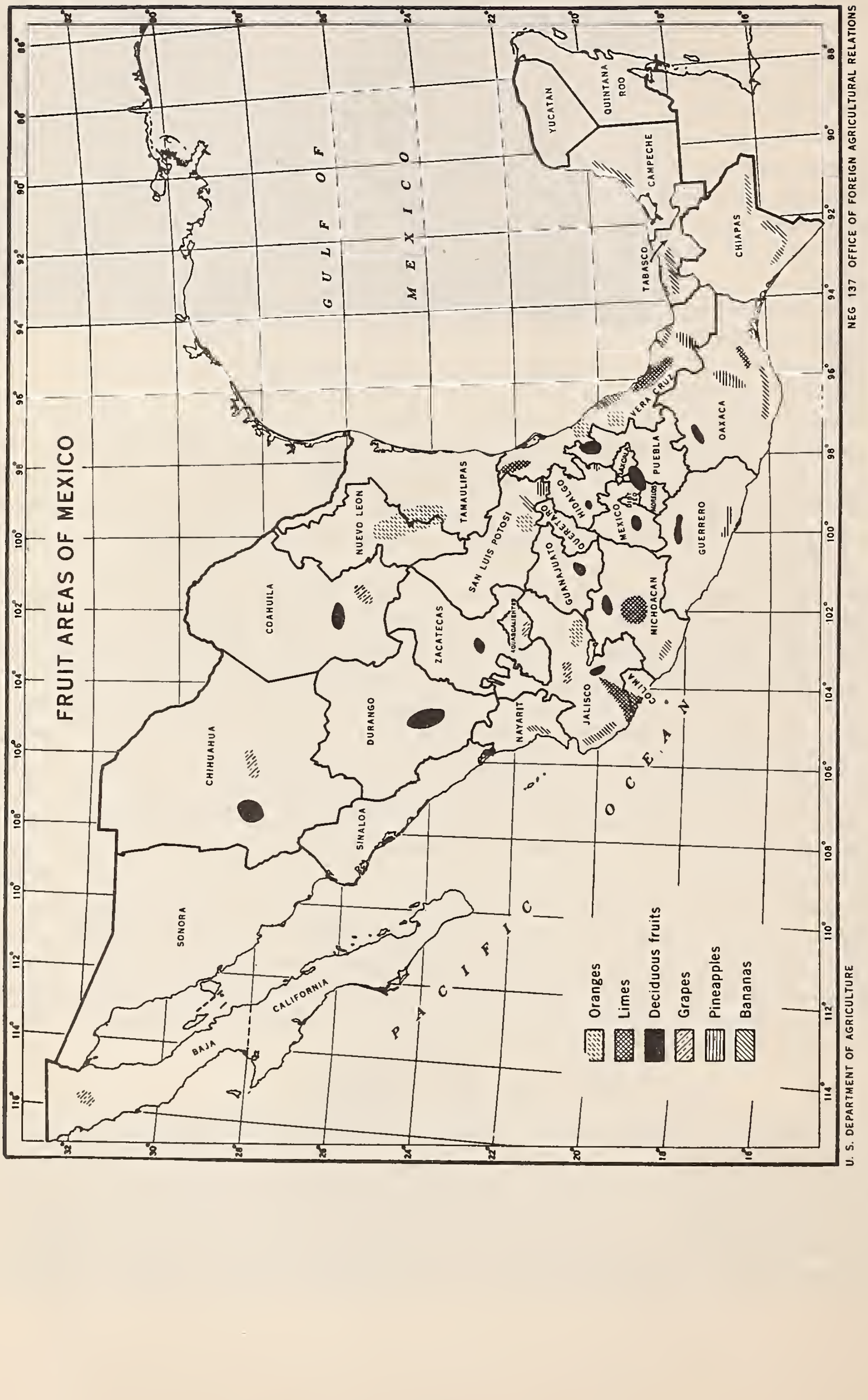


FIGURE 9.-Map of Mexico showing fruit areas.

the task of preparing a detailed study of the industry is not an easy one. Furthermore a large volume of fruit in Mexico, produced from dooryard trees, is consumed at home and is therefore unaccounted for.

Fruit of some kind is grown in every State in Mexico. In some the volume is small; in others it reaches surprising proportions. Deciduous fruit is produced in varying quantities in the high mountain valleys or plateaus where the elevation ranges from 5,000 to 8,000 feet. Oranges are produced throughout the Republic, but commercial development is restricted to areas having most suitable climatic conditions and adequate transportation facilities. Tropical fruits of all kinds are produced along the coastal plains, where rainfall is abundant and no frost occurs. They are produced without effort, and practically every home is assured of a supply of seedling oranges, papayas, sapotes, mangoes, etc. These are often found growing wild in the forests and are to be had for the gathering.

As highways are developed, fruit culture will probably expand. The commercial production of bananas,[2] pineapples, and limes for export is of long standing. Both citrus and deciduous fruits have also been produced for many years, in fact since the coming of the Spaniards, but for home consumption only.

Expansion of the fruit industry in Mexico, like that of all other types of agriculture, is limited by the extent of arable land. Irrigation projects under construction in certain areas will provide additional land for farming, but it is not expected to be given over to fruit production, at least to any important extent.

The banana industry has suffered a severe set-back because of the rapid spread of the sigatoka disease. Lack of proper control methods has already forced the abandonment of large areas. The planting of deciduous fruits has increased in certain areas, particularly of apples, pears, and plums. The planting of vineyards is also on the increase. Because of unfavorable climatic conditions, however, the future of these plantings is insecure. Pineapple production shows a certain amount of fluctuation but has remained fairly stable during recent years. (See table 1.)

TABLE 1.-*Production of principal fruits in Mexico, 1936-41*

COMMODITY	1936	1937	1938	1939	1940	AVERAGE 1936-1940	1941
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
Citrus:							
Limes	23,815	22,047	26,559	34,110	35,916	28,489	40,027
Oranges	160,385	162,199	184,299	202,025	229,234	187,628	242,007
Tropical:							
Avocados . . .	33,766	31,710	40,386	50,665	56,886	42,683	63,836
Bananas	685,497	711,973	709,078	706,760	442,320	651,126	412,460
Mameys	14,828	14,945	16,014	16,460	15,407	15,531	14,212
Mangoes	78,506	69,308	68,004	79,858	94,517	78,039	98,131
Pineapples . .	46,408	47,038	40,118	36,031	44,339	42,787	55,700
Deciduous:							
Apricots . . .	2,668	2,966	3,051	3,212	3,407	3,061	4,743
Apples	28,701	26,503	28,633	36,783	44,359	32,996	48,508
Figs	5,890	6,045	5,885	9,762	7,945	7,105	8,791
Grapes	13,256	12,677	13,550	13,911	13,634	13,406	18,655
Peaches	30,476	28,595	36,956	43,564	38,348	35,588	48,071
Pears	6,958	7,910	8,804	11,042	11,232	9,189	12,838
Plums	30,594	-	-	-	-	-	-
Quinces	9,833	10,422	10,258	10,257	12,647	10,683	16,284

Compiled from official sources.

---

[2] In this report the term banana is applied to both the plantain *(Musa paradisiaca)*, which is used mostly for cooking, and the banana *(Musa sapientum)*, the fruit eaten out of hand and most commonly known in importing countries as the banana.

The greatest increase in production has been in citrus fruits, particularly oranges and limes. Enthusiasm at the moment is running high, and there has been a large increase in planting during the past 5 years. A greater domestic demand for oranges and the growing popularity of Mexican limes and lime products in the United States are largely responsible for this increase.

Fruit growing in Mexico offers possibilities to those who are prepared and equipped to produce it in an intelligent, scientific, and efficient manner. Much of it finding its way to market today is produced with a minimum of expense and attention. Grades and standards used in most countries in preparing fruit for market are unknown. Sizes are important from a sales standpoint, but grade defects play no part in the merchandizing program. Appearance and presentation are treated as being of minor importance. Fruit and vegetables are sold in bulk for the most part. When packages are used, they are mostly made on the farm and are in the form of hand-woven wicker or fiber-braided baskets and crates made of bamboo or sticks bound together with leather or fiber. Dried figs, for example, are sewed in bags made of cowhide.

Handling methods are extremely rough and result in a high percentage of bruised fruit, decay, and loss. Transportation is slow and usually inadequate. A shortage of rolling stock exists, and not only are refrigerated cars difficult to obtain but icing and freight charges are high.

Citrus and tropical fruits are the most important, horticulturally speaking, in the economy of the country, but deciduous fruits are appreciated, and their production is being increased. Mexico has great possibilities in the way of commercial fruit production. Present methods of growing and handling, however, are primitive in comparison with established practices in certain other countries where such methods are more advanced.

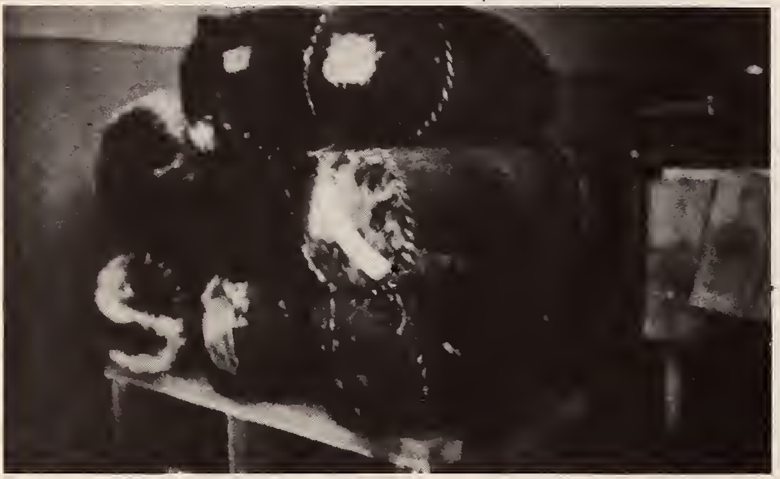


FIGURE 10.-Dried figs in cowhide bags.

CITRUS FRUITS

Many types of citrus fruits are produced in Mexico, but commercial development has been largely restricted to oranges, limes, and mandarins. Because of the wide physiographical variations and their influence upon climatic conditions, these fruits are found scattered over the greater part of the country. In regions where water is scarce, a few citrus trees form a part of the miscellaneous dooryard planting; but in regions where there is abundant rainfall, or irrigation water is available, oranges and limes are extensively cultivated and are even found growing wild. Oranges have the widest range of adaptability in Mexico and are found to a greater or lesser extent in every State, from the Río Grande to Yucatán and from Sonora to Veracruz.

The lime, however, because of its susceptibility to low temperature is much more restricted in range and is confined to the lower latitudes and elevations where tropical conditions prevail. The mandarin group of oranges (*Citrus nobilis*) is grown along with sweet oranges (*Citrus sinensis*). They are in limited supply, however, and no attempt has been made to plant them in separate blocks. The fruit is well adapted to Mexican conditions, and its use is gradually increasing.

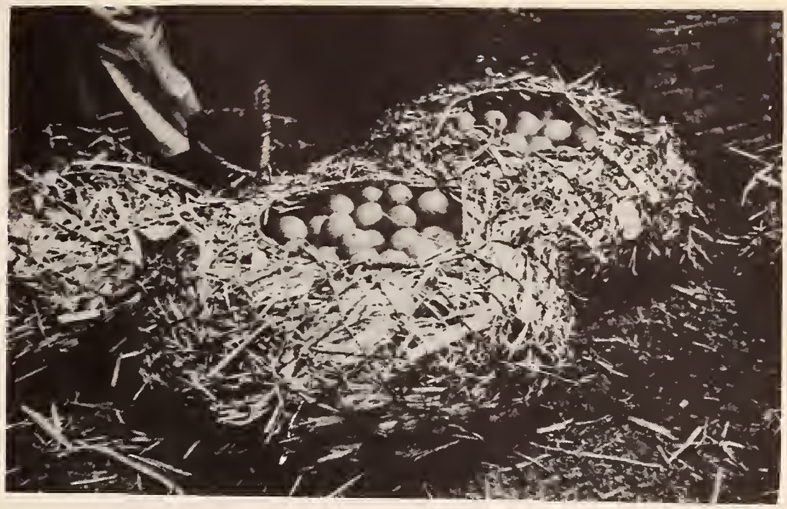


FIGURE 11.-Straw-lined baskets made of cord in which oranges are transported by truck from Atotonilco to Guadalajara.

A few grapefruit (*Citrus paradisi*) are produced in the country, but they have failed to attract public interest, and for that reason attempts to commercialize the industry have not been successful. The principal outlet in the country is Mexico City. Fruits such as kumquats (*Fortunella* spp.), loquats, (*Eriobotrya* spp.), and similar hybrids are produced largely for personal gratification or as a matter of experimentation. There are no commercial plantings, and the fruits are available only in very limited quantity.

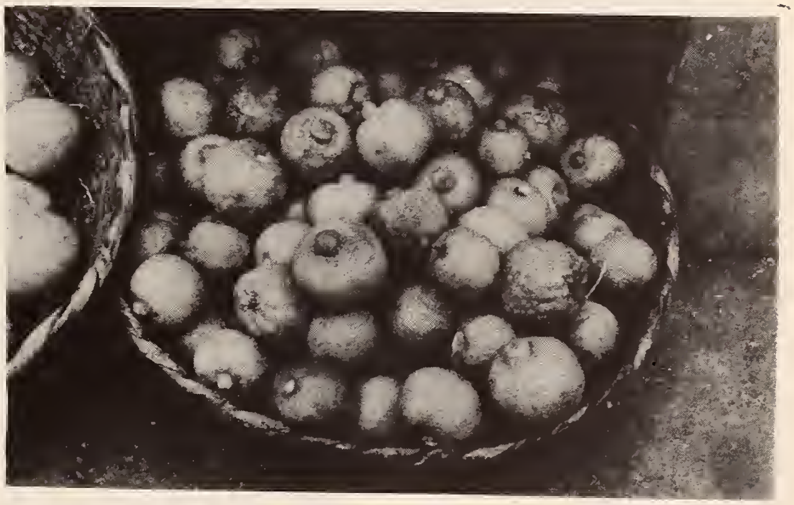


FIGURE 12.-The *lima* or *lima dulce* as it is known, is rather widely used in Mexico but to United States palates is quite insipid and unattractive.

The lemon (*Citrus limonia*), which is extensively grown in California, Italy, and other countries bordering the Mediterranean, is of no commercial importance in Mexico. Plantings made years ago for exportation to the United States did not prove successful, and the project was abandoned in favor of limes. Mexico, however, does produce a type of lemon known as the *lima dulce* (sweet lemon), which appears to be a cross between the orange and the lemon. It produces a fruit somewhat similar in size, shape, and appearance to a lemon, but it has a sweetish, rather insipid, neutral flavor and is eaten out of hand like an orange. Though it is rather widely used in some sections of Mexico, its acceptability in other markets is extremely doubtful.

In Mexico the words lemon and lime (*Citrus limonia* and *Citrus aurantifolia*) are used interchangeably. The literature, statistical data, and all other references pertaining to lemons and limes are very much confused. Though the production of lemons is negligible, the growing of limes has developed into an industry of considerable importance. Inasmuch as oranges and limes are the only citrus fruits produced in commercial volume, detailed discussion will be confined to these types.

ORANGES

Oranges, as far as climate is concerned, are adapted to the greater part of Mexico (see fig. 13). Their commercial development, however, has been restricted to certain well-defined areas. Rugged mountain barriers, insufficient moisture, poor transportation facilities, and a lack of arable land have all made greater expansion difficult. Despite the many natural handicaps, oranges are found growing in widely scattered areas, from the tropical coastal plains to high mountain plateaus and valleys, where climatic conditions are between subtropical and temperate. They are produced in arid and semiarid regions where the supply of moisture is partially or entirely dependent upon irrigation and in tropical areas where the annual rainfall in some places exceeds 100 inches.

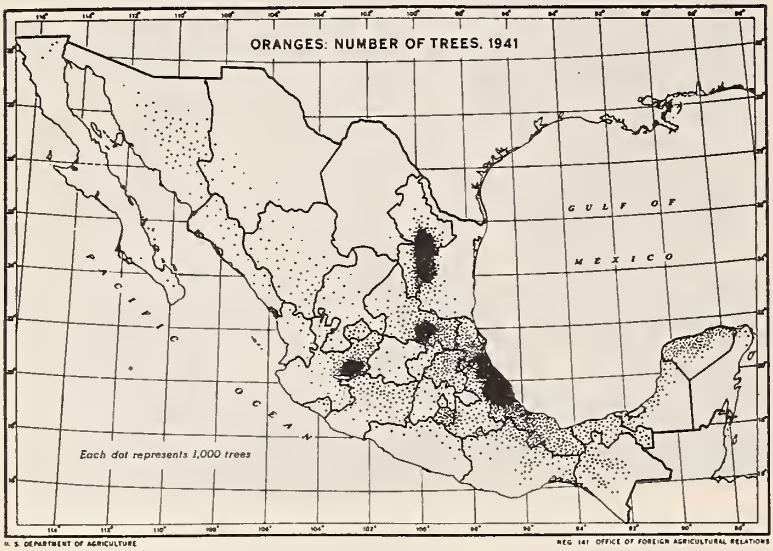

ORANGES: NUMBER OF TREES, 1941
GULF OF MEXICO
OCEAN
Each dot represents 1,000 trees
U. S. DEPARTMENT OF AGRICULTURE
NEG. 141 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 13.-Distribution of orange trees in Mexico.

The districts producing commercially, however, are confined to a few regions where not only climatic conditions are favorable, but suitable transportation facilities exist. Transportation is one of Mexico's chief problems; and, though citrus fruit could be produced successfully in other areas, the difficulty of moving it to market reduces the opportunity for commercial expansion.

Producing Regions

The development of the citrus industry has taken place principally along the lines of communication. The old established groves follow the railroads and rivers, and the newer plantings are along the more recently constructed highways. Since the completion of the Pan American Highway between Laredo, Texas, and Mexico City, the expansion of citrus plantings has been rapid and extensive, especially south of Monterrey in the States of Nuevo León, Tamaulipas, and San Luis Potosí.

Although, according to official statistics, Veracruz at present leads in both production and number of producing trees, Nuevo León, which is second, offers greater possibilities for commercial development. The State of Jalisco ranks third in number of trees but fourth in production, and San Luis Potosí ranks fourth in tree population but third in production. Puebla and Yucatán come fifth and sixth, respectively, in both number of bearing trees and production (see table 2).

Nuevo León. No official data are available on nonbearing trees, but from observation and interviews with reliably informed people, the writers conclude that planting of young trees has been heaviest in the State of Nuevo León. On this premise, Nuevo León is expected within the next 4 or 5 years to outrank the other States in both number of bearing trees and production.

Nuevo León is one of the States bordering the United States and extends from about 23° to 28° north latitude. It is served by railway and by the Pan American Highway. Monterrey is the capital of Nuevo León and the third largest city in Mexico. From Monterrey north to the Río Grande, there is a continuous stretch of desert, which is undeveloped, sparsely settled, and covered with cactus, yucca, mesquite, and the characteristic desert chaparral. From Monterrey south, however, the country changes from the hot, arid, unfriendly desert wastes to mountains and valleys. The slopes of the mountains, which are a part of the Sierra Madre Oriental chain, are covered with trees and shrubs, and the valleys are planted to citrus, corn, sugarcane, and other cultivated crops.

TABLE 2.-*Number of trees and production of oranges in Mexico, by States, 1937-41*

STATES	NUMBER OF TREES					PRODUCTION[1]				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*
Coahuila	(2)	1	(2)	(2)	1	1	1	2	2	2
Chihuahua	11	12	11	12	14	29	31	31	41	63
Durango	53	83	60	52	43	138	125	152	152	195
Nuevo León	359	415	420	415	423	716	921	785	931	824
San Luis Potosí	244	242	270	260	257	443	352	640	726	796
Tamaulipas	57	60	71	71	73	110	119	162	155	207
Zacatecas	18	19	25	25	21	28	30	54	59	71
Campeche	35	36	38	35	39	99	104	113	110	107
Quintana Roo	4	9	7	6	6	12	9	17	20	20
Tabasco	42	43	49	51	51	103	111	168	163	162
Veracruz	536	671	732	774	781	943	1,154	1,420	1,614	1,718
Yucatán	88	96	114	114	114	182	183	267	317	449
Baja California	5	6	8	6	6	12	13	13	22	16
Nayarit	8	8	9	9	9	15	16	16	32	32
Sinaloa	11	13	18	19	20	27	29	39	70	51
Sonora	72	56	51	49	58	146	168	134	161	221
Colima	4	6	6	5	5	10	21	27	27	17
Chiapas	52	58	64	65	64	128	156	172	211	184
Guerrera	19	18	18	19	19	53	50	41	43	51
Oaxaca	48	54	56	57	99	98	110	116	136	142
Aguascalientes	15	12	13	13	11	42	25	24	39	32
Distrito Federal	—	(2)	(2)	(2)	1	—	2	2	2	2
Guanajuato	19	17	11	13	13	49	45	25	23	29
Hidalgo	77	83	91	90	84	162	213	260	262	267
Jalisco	327	325	285	270	236	612	763	502	584	591
Mexico	13	14	15	15	14	27	31	28	31	30
Michoacán	79	81	63	65	84	168	177	152	176	213
Morelos	6	7	26	26	27	11	12	73	75	76
Puebla	134	137	136	135	131	261	286	303	328	315
Querétaro	4	4	14	14	13	8	8	33	37	30
Tlaxcala	1	(2)	(2)	(2)	(2)	1	1	1	1	1
Total	2,341	2,586	2,681	2,685	2,717	4,634	5,266	5,772	6,550	6,914

[1] In 70-pound boxes.

[2] Less than 500 trees.

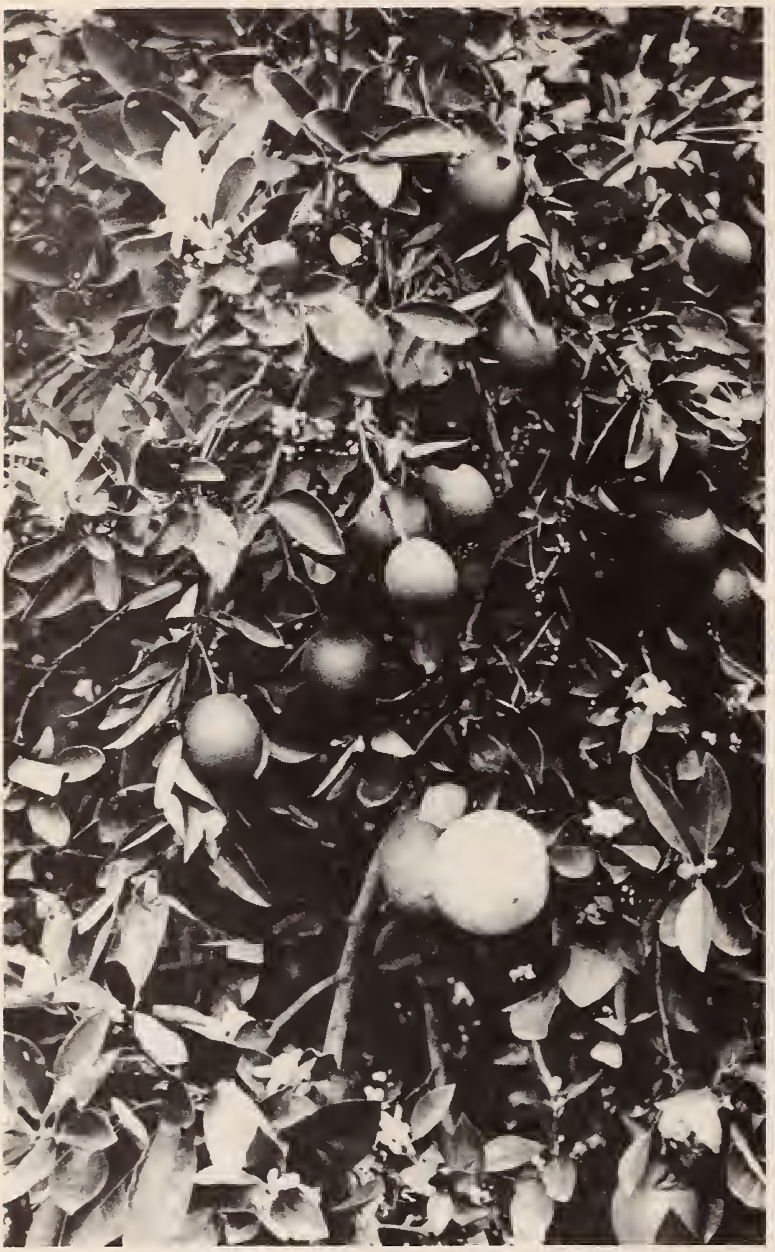


FIGURE 14.-Heavy orange production showing all stages from flower to mature fruit.

Oranges have been grown in Nuevo León for many years, but after the completion of the Pan American Highway in 1936 some drastic changes in production occurred. The highway opened up a new country and gave access to market outlets heretofore untouched.

The orange district of Nuevo León begins about 12 miles south of Monterrey and extends almost continuously for a distance of over 100 miles. A few breaks occur because of abrupt changes in terrain, but these are of short duration. The industry centers around Montemorelos, where intensive plantings have been made. The highway passes for a considerable distance through a quite narrow valley, ranging from about 0.5 mile to some 3 to 4 miles in width. The elevation of the valley floor is about 2,000 feet, with a range of mountains on each side rising to heights of about 5,000 feet.

According to official and private estimates, the number of orange trees in the State of Nuevo León ranges from a million to something over 2 million trees. A conservative estimate, however, would place the figure somewhere between a million and a million and a half, including both producing and nonbearing trees. One authority estimates the number of bearing trees at 900,000 to 1,000,000 with an additional 1,220,000 trees from 1 to 4 years of age. Another places the total at 1,000,000, about 50 percent of which are in bearing. According to the official government statistics of 1940, Nuevo León is credited with 415,000 trees of producing age. During 1941 about 300,000 trees were set out, and about the same number were expected to be planted during 1942.

Irrespective of the exact number of trees, either bearing or nonbearing, one can say without hesitation that plantings during recent years have been on a large scale and that a substantial increase in production can be expected during the next few years. The potential productive capacity is estimated at more than 7,000 carloads of fruit, calculated on the basis of 1,000,000 trees, averaging 500 oranges per tree, and 70,000 oranges per car.

Many groves in this area are from 20 to 50 acres or more in size, but the average young planting is only from 1 acre to 4 or 5 acres. The attractive prices that oranges have been bringing during recent years have stimulated much interest in the future of the orange business. Enthusiasm has been and is still running high. Many small farmers have abandoned the cultivation of customary crops, such as corn, beans, and cane, and have planted their land to oranges.

A survey of orange plantings paralleling the highway between kilometers 983 and 799 (see fig. 17) gives a fairly good illustration of the way in which expansion has taken place. Though a few small scattered plantings are found beyond these points, the first heavy concentration of young plantings commences at kilometer 983 and continues for an almost unbroken stretch to kilometer 910. Because of a stretch of mountainous country, a short break in plantings occurs, but between kilometers 899 and 799 is another extensive development, a part of which, however, is on dry land to which it may be difficult to get water in years when irrigation is necessary. The heaviest concentration of new plantings has been made between kilometers 927 and 800.

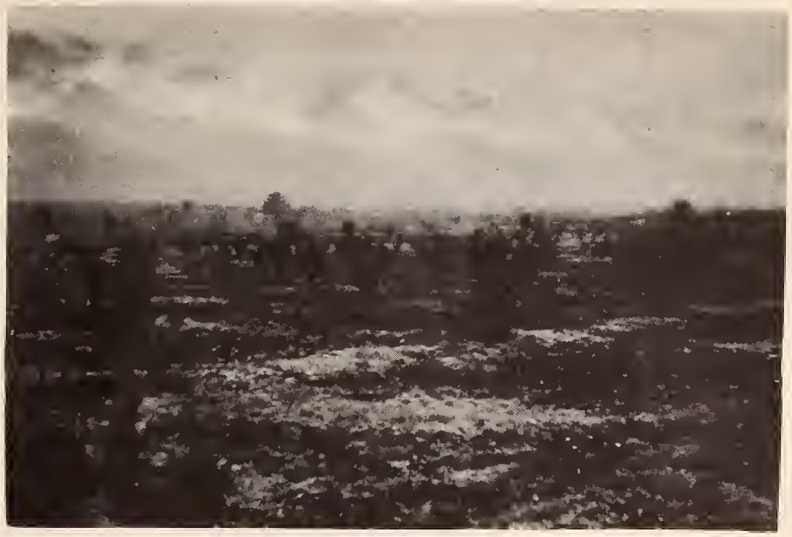


FIGURE 15.-A planting of young orange trees in Nuevo León.

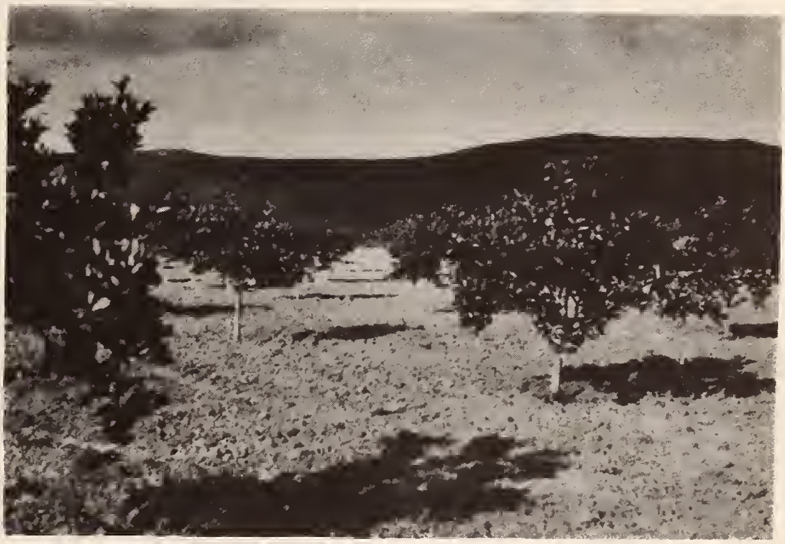


FIGURE 16.-A grove of 3-year-old orange trees along the Pan American Highway, Nuevo León.

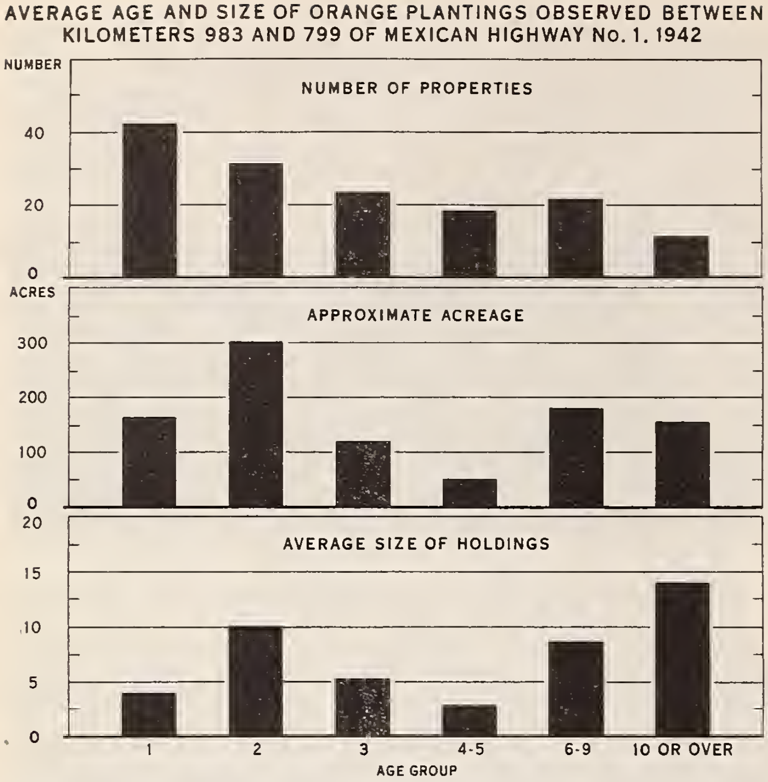


FIGURE 17.-Frequency chart showing concentration of planting between Monterrey and Victoria paralleling the Pan American Highway.

An interesting feature in connection with the recent expansion is the size of the individual holdings. A large percentage of them are small, ranging from 0.5 acres to 2, 3, and 5 acres in size. An occasional planting of 10, 15, or perhaps 25 acres was observed, but groves of this size are the exception rather than the rule. The older producing groves, from 8 to 10 years and older, are generally laid off in blocks of 15, 20, and even 50 acres.

Rainfall in this area usually ranges from 31.5 inches at Linares to 15.5 inches at Montemorelos, which is generally sufficient to mature the crop. In some years, however, precipitation is much less, and moisture requirements must be provided in part by irrigation where possible. Many of the new plantings are on nonirrigated land, but additional plantings may be made northeast of Monterrey in the area to be irrigated by the Azúcar Dam project.

Trees in this area begin to bear at from 3 to 4 years of age, reaching commercial production at about 6 years. The average production per tree is about 500 units. Some 5- to 6-year-old trees are said to produce up to 900 or 1,000 oranges. The sizes tend to run large, which in Mexico is a distinct advantage from a marketing point of view, since small sizes are usually discounted by about 50 percent.

The first important producing center is around Allende, about 20 miles south of Monterrey. Seedling oranges have been grown in this district for many, many years, but it was not until 1890 or 1895 that an interest was developed in the planting of budded stock of known parentage. Local growers estimate that 200,000 orange trees have been planted in the Allende area, about 50 percent of which are in production. The producing trees are 10 years old and older, whereas practically all the young groves have been established within the past 5 years. The new groves have been planted largely on dry land, without irrigation. The older orchards in this area are under irrigation.

The navel orange has not proved profitable around Allende. It is a shy bearer and is, therefore, being removed and replaced with Parson Brown, Murcia Blood, and a local variety known as Chinese.

Oranges in this district are said to be yielding a higher cash return than other crops. Certain lands, particularly hillsides, that have become more or less depleted

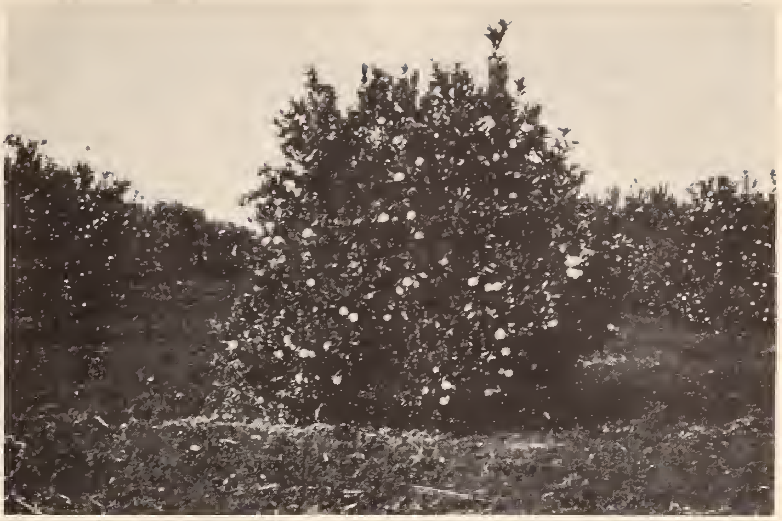


FIGURE 18.-A well-cultivated orange grove near Montemorelos.

of their fertility and are unsuited for other crops are said to give sufficient returns to make their cultivation profitable if planted to oranges. The higher lands yield fruit of smaller size but of a superior flavor and a higher sugar content.

The most important producing area centers around Montemorelos, which is 50 miles south of Monterrey. Here, too, oranges have been grown for many years, but the industry was not established on a commercial basis until 20 years ago. Twelve years ago the district had a total of only 25,000 trees. The present number is unknown but is believed to approximate a half million or more trees. In 1935 the industry suffered a heavy set-back as a result of a severe freeze. Young trees from 1 to 3 years old were killed outright, and older trees were badly damaged. Extensive plantings of young trees are in evidence throughout the whole area, indicating much optimism regarding the future of the industry.

Some of the older orchards planted on dry land are said to be deteriorating. The demand is active for irrigated land that can be set to trees, but little desirable land is left. Irrigated land near the highway is selling for 500 to 600 pesos per hectare ($42 to $50 per acre). The same land, before the present planting boom developed, was valued at from 100 to 150 pesos.

Total production in this area is difficult to estimate because of the effects of the freeze in 1935 and the large number of young trees just coming into bearing. In 1941 about 120 carloads were shipped, in addition to a considerable volume moved out by truck. The average production per tree is around 500 oranges. A reasonable assumption is that within the next 5 years total production in the Montemorelos area may exceed 4,000 cars.

From Montemorelos the highway follows the valley to Linares, a smaller but also important center. The soil in this area is black and reminiscent of that of the Corn Belt in the United States Middle West. Rather extensive plantings have been made in this area on dry land. Though the young trees appear sufficiently healthy and vigorous at the moment, a debatable point is whether moisture will be adequate during years of low rainfall to support mature trees carrying a full load of fruit.

Tamaulipas. The State of Tamaulipas, though it is not a major producing State, in 1940 produced 4,900 metric tons (155,000 boxes) of oranges. The soil of the Victoria area is heavy, quite fertile, and, where cultivated, is given over largely to the production of corn, sugarcane, and fiber plants. The holdings near Victoria are fewer but larger than those in Nuevo León.

The other citrus-producing area in Tamaulipas is located close to Tampico. This part of the country is low and flat, ranging from sea level to 300 feet in altitude.

Just west of Tampico are a number of lagoons and small lakes, around which orange groves have been planted. The plantings are mostly on the higher ground, which slopes gently toward these small bodies of water. The natural vegetation consists of palmetto, scrub pine, and other subtropical growth. The rather wide expanse of flat land, dotted with palms and palmettos and interspersed with citrus, is somewhat similar to the orange districts of Florida.

About 200,000 young orange trees have been planted in this area during the past 4 years. They are located mostly in the area served by the highway connecting Tampico with the Pan American Highway. In this district one producing grove of 17,000 to 18,000 trees is said to be earning, clear, $1 (United States) per tree per year.

Most of the original stock planted in the Tampico area was introduced from Florida. This was because of the similarity between the two regions in soil and climate. An original stand of Washington Navels, between 50 and 60 years old, is still producing good crops. The present varieties are pretty equally divided between navels, blood oranges, Valencias, and Parson Browns, but the present trend is toward the Valencia. In addition to these, the area produces some seedlings and what are known locally as smooth oranges.

Production is not uniform and varies according to variety, age of tree, and condition of grove. Some rare trees are said to produce up to 5,000 units per tree, but the average is about 500.

San Luis Potosí. A few miles below the city of Victoria the highway crosses the Tropic of Cancer. Vegetation characteristic of a more temperate clime is left behind, and the growth of the Tropics takes over. The mountain slopes, once entirely forested, have been cleared and planted to corn. The valleys and more accessible plots of land are covered with bananas, sugarcane, citrus fruits, pineapples, and tropical jungle. Two important producing areas are in this State, one at Valles, on the Pan American Highway, and the other at Río Verde, a higher interior valley some 75 miles to the west, accessible only by rail.

The elevation at Valles is about 300 feet. Limes are said to be indigenous to this area; but, since they are occasionally injured by light frosts, it cannot be regarded as a thermal belt. The area, however, seems to be admirably adapted to the production of oranges. On certain soils they attain a high state of perfection. The bottom lands and hillsides bordering the Río Fujal are especially well suited to them, as is forcibly demonstrated by the growth and productivity of the trees.

FIGURE 19.-A grove of 5-year-old orange trees.

In one grove visited, 5-year-old trees were at least as large as trees double their age grown under less favorable conditions. They were producing approximately 1,200 fine large fruits per tree, and trees 9 and 10 years of age were carrying up to 2,000 oranges. The trees were planted 8 x 8 meters (26 x 26 feet) apart, which is proving much too close.

While the number of bearing trees in this area is not great, enthusiasm for citrus culture is running high. Land values have increased sharply, and acreage is being cleared in all directions to make way for new plantings. Small nurseries have been established in various places, and trees have been distributed at a small cost or, in certain instances, free to prospective planters.

Valles, at present, is considered more important as a lime-producing center, but interest in oranges is increasing, and it appears destined to become more and more important as an orange-growing district.

The principal commercial producing area of oranges in San Luis Potosí is at Río Verde. The Río Verde Valley is situated some 200 miles north of Mexico City, a railway journey of about 20 hours. It is served by a branch-line railway operating out of San Bartolo, which is on the main line between the cities of San Luis Potosí and Tampico. The region is more or less isolated and is dependent almost entirely upon the railroad for access to the outside world. There are no improved roads in the district, and the trails now in use are impassable during parts of the year.

The Río Verde Valley is an old agricultural district. Oranges, among such other crops as sugarcane, corn, and beans, have been produced for many years. The valley is reminiscent of the old *hacienda* days, with its broad expansive cultivated fields, extending in all directions from the villages. It is wide and fertile, lying between two spurs of the Sierra Madre Oriental. Where water is unavailable, the land is a desert with a sparse covering of stunted vegetation. The elevation is about 3,280 feet, and climatic conditions are in sharp contrast to those at Valles, which is only 75 miles away. These abrupt changes and sharp contrasts are characteristic of Mexico.

The valley contains about 60,000 to 80,000 acres of arable land, about 6,000 of which are under irrigation. According to local authorities, it is said to have a total of 280,000 trees, of which 150,000 are in production and 130,000 range from 1 to 5 years of age.

The trees are located mainly in and about the town of Río Verde. There are no large commercial blocks, such as are found in most areas. Most of the plantings run from a few trees planted in the back yards of homes to small plantings of 2.5 to 12 acres. Because the individual holdings are small

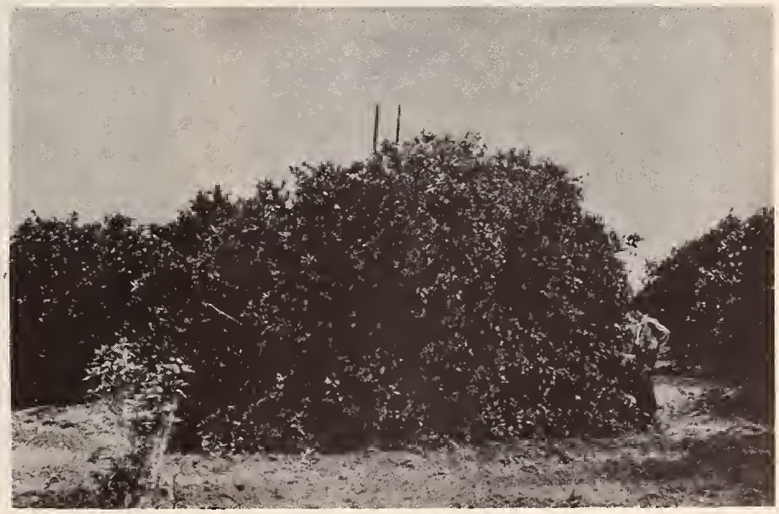


FIGURE 20.-Well-grown and vigorous tree in a grove at Río Verde, San Luis Potosí.

and scattered, a false impression of the importance of the industry is created. To the casual observer, the tonnage produced in this valley does not appear impressive, but when all the fruit is gathered from the many small holdings, the aggregate is considerable.

About 50 percent of the plantings consist of seedling trees, or criollas, but in recent years there has been a rather active interest in new plantings, and the trend has been mostly in the direction of budded varieties, such as navels, Valencias, bloods, and mandarins. The older groves are between 40 and 50 years old and are still producing good crops of fruit. The trees in this district begin to bear at from 4 to 5 years of age, but the general practice is to plant rather mature nursery stock. Trees 6 to 7 years old and older are said to average from 600 to 700 fruits, and some older groves are producing in excess of 1,000 per tree.

Commercial production amounted to 650 carloads by rail and an estimated 50 carloads by truck during the 1941 season. Of the total, mandarins were estimated at 45 carloads. There are no single or solid plantings of mandarins, but they are scattered among the orange trees.

The nights in this valley are cool, and in certain seasons cold and damp. Frosts occur occasionally and cause considerable damage, especially to the trunks of young trees. As a protection against low-temperature injury, the trunks and framework

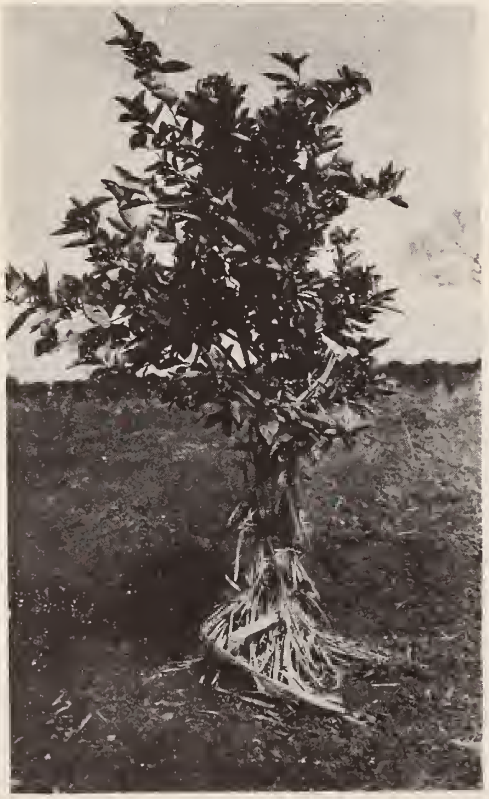


FIGURE 21.-Young orange trees protected by sugarcane leaves.

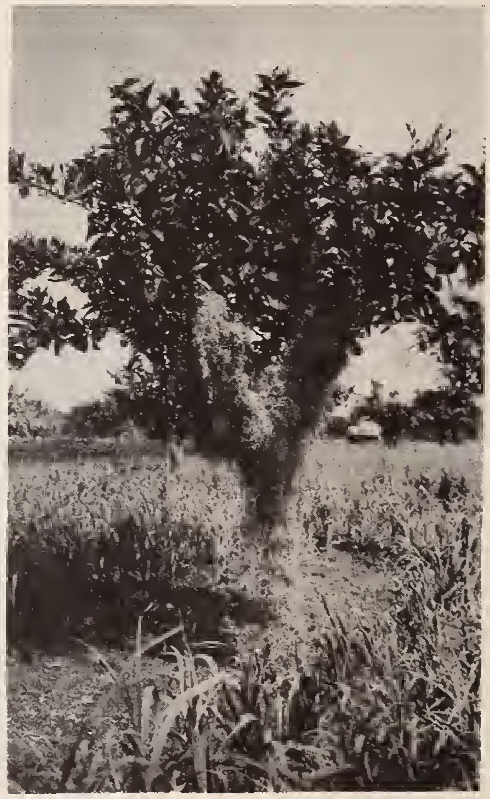


FIGURE 22.-Young orange trees protected by wrappings of Spanish moss.

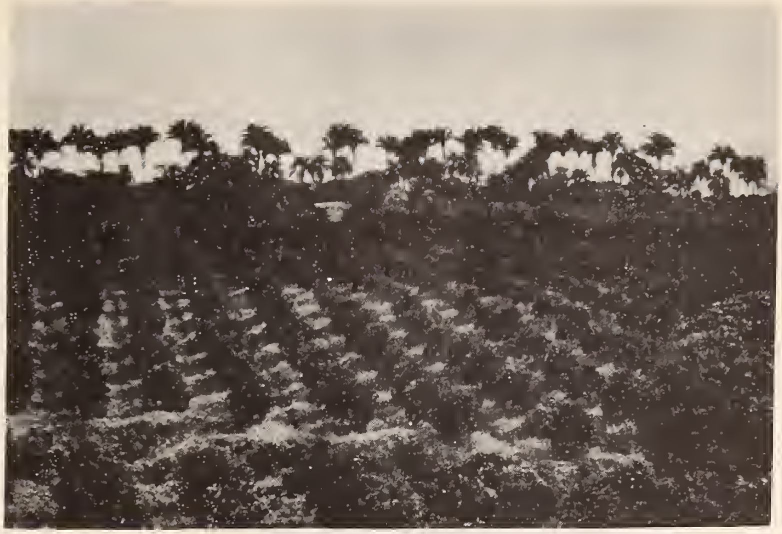


FIGURE 23.-Grove at Fortin, Veracruz, with young plantings in the background and a large mango in the foreground at the right.

branches of young trees are wrapped with leaves of sugarcane and Spanish moss. The sudden drops in temperature, rather than the severity of the cold itself, cause injury to the trees.

Another important orange-producing center is Tamazunchale, on the highway some 65 to 70 miles south of Valles. Practically all the oranges produced in this district, however, are of seedling varieties and are consumed at home. The country around Tamazunchale is extremely rugged, and the production of oranges is more or less restricted to the small mountain valleys and slopes. Most of the mountainsides rise very sharply, sometimes being almost perpendicular. From the floor of the valley, which in part is traversed by the highway, the mountains rise to heights of 7,000 feet. Wherever possible the mountainsides are under cultivation or in pasture, and the pattern of tilled fields and grazing plots is from a distance like an intricate piece of mosaic. This district is inhabited largely by Indians, who are primitive in their farming methods and way of life, and they cling tenaciously to their small patches of land. The general character of the country, its profile, the crops it produces, and the methods of tillage remind one of certain parts of Europe, especially Switzerland, Bavaria, the Italian Tirol, or, in exaggerated form, regions in the Cumberland and Alleghany Mountains.

Veracruz. From the standpoint of production and number of bearing trees, Veracruz is the most important orange-producing State of Mexico. It is a long, narrow State following the coast line of the Gulf of Mexico between parallels 18 and 22. It is approximately 400 miles long and from 40 to 75 miles wide. The largest part of the State is in the Torrid Zone, but the altitude varies from sea level to 18,500 feet. Mount Orizaba, the second highest peak on the North American Continent, lies at the western boundary of the State.

The crops produced in Veracruz are in a general sense those that belong to a tropical climate, but at higher elevations deciduous fruits and crops grown under Temperate Zone conditions are found. In some areas, for example, though freezing temperatures seldom occur, 9 months are required for corn to mature.

In addition to a long list of tropical fruits, flowers are found in endless profusion, including gardenias, camellias, bougainvillaea, poinsettias, fuchsias, hibiscus, and magnolias. Oranges are grown more or less throughout the State, but the commercial developments are centered largely around Jalapa and Córdoba.

Jalapa is 63 miles northwest of the city of Veracruz. The elevation at Veracruz is about 3 feet; at Jalapa it is 4,854. To reach Jalapa from Mexico City one must

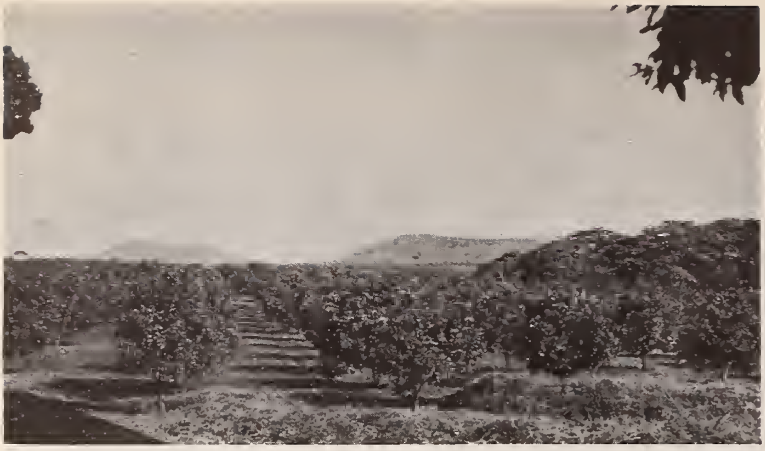


FIGURE 24.-Orange grove near Jalapa.

climb two mountain ranges, which at some points reach an elevation between 11,000 and 12,000 feet; cross a high mountain valley at an elevation of 8,000 or 9,000 feet; travel through lava-strewn mountains; and descend abruptly to Jalapa.

Jalapa, though in a mountain valley, is a city built upon hills. The surrounding countryside is rugged, mountainous, and in many parts quite inaccessible. Jalapa is really a coffee district, producing some of the best grades grown in the State of Veracruz. Oranges, though widely grown, are for the most part subsidiary to coffee. In fact, they are used as an intercrop, the bulk of the production coming from trees planted between coffee trees.

The amount of tillable land in this area is decidedly limited; most of the crops are grown on steep rocky hillsides. The area is, however, especially adapted to coffee, but other crops, such as bananas, pineapples, and oranges, do well because of the fertility of the soil and the abundance of rainfall.

Altogether about 500,000 orange trees are planted in this district, according to estimates. The holdings are generally large. Three growers, who are also coffee planters, together have a total of 165,000 trees. One grower visited had 110,000 trees, 35,000 of which were in production, and in the spring of 1942 he set out an additional 15,000 young trees. Another planter had 100,000 trees in bearing and in addition several thousand young trees.

A large number of the trees in this area are seedlings of various types, and, because of climatic conditions and methods of culture, do not begin to bear commercial crops until they are about 9 years of age. Budded trees, on the other hand, start producing commercial crops at 6 to 7 years of age. Budded stock is being more generally used, although it is also planted between coffee. Though seedlings constitute some 70 percent of the total, Valencias, navels, and Jaffas are receiving increased attention.

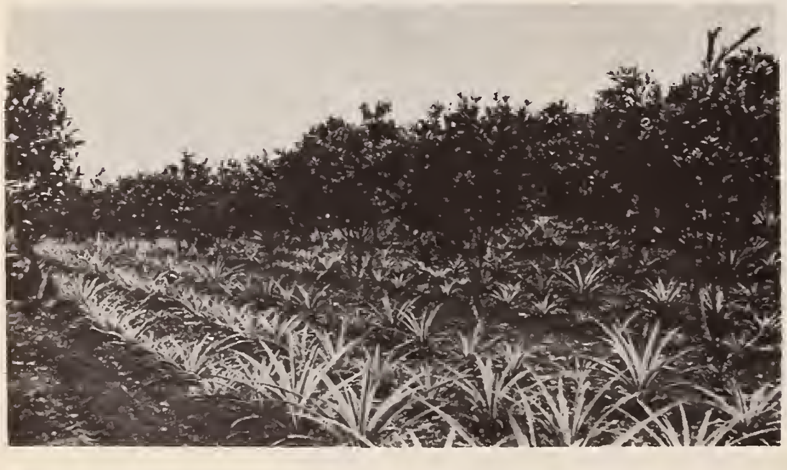


FIGURE 25.-Experimental interplanting of pineapple with oranges at Jalapa, Veracruz.

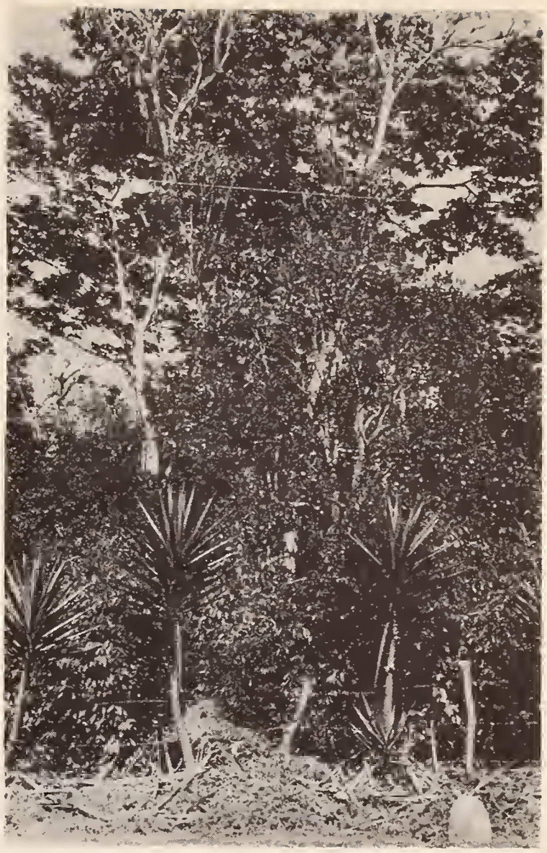


FIGURE 26.-Mixed plantings in Veracruz, showing young coffee trees, high-headed orange trees, and forest trees.

Córdoba is another important orange district. The distance from Jalapa to Córdoba by air line is approximately 45 miles, but in order to bridge the gap between the two districts several hours of travel by a circuitous route are required. Jalapa lies in the foothills northeast of Mount Orizaba, and Córdoba is to the southeast. To reach this latter area from Mexico City one must climb to an elevation of about 8,000 feet, cross the high plateau through a part of the State of Puebla, and descend again to an elevation of around 2,700 feet. This road, though very interesting to the tourist, presents a difficult problem of transportation to the commercial fruit grower.

The towns of Orizaba and Córdoba are in a deep valley on the south slope of Mount Orizaba. The climate is more tropical than that found on the Jalapa side. Whether any other road of similar length has as much to offer in the way of scenery and such amazing contrasts as that between Córdoba and the plateau above is doubtful. Córdoba affords a retreat from the steaming heat of the Tropics below, but climatic conditions are conducive to perfection in the growth of oranges, pineapples, bananas, avocados, sapotes, and a host of other luscious fruits. The upper end of the valley is devoted largely to the cultivation of general farm crops.

Over a half million orange trees are planted in the valley, with a sprinkling of mandarins, limes, lemons, and kumquats. At present most of the oranges are planted as intercrops with coffee; but, since oranges have been a rather profitable crop in recent years, the tendency there is to remove the coffee trees and concentrate on citrus, particularly oranges.

A large number of the oranges produced in the area are seedlings, but in recent years more attention has been given to budded stock, especially navels. The Valencia and Murcia Blood bear quite well, but the preference is in favor of navels. The mandarin group of oranges seems well adapted to this area, and additional plantings are being made to meet the increased demand.

In a grove of navels planted in 1932, the trees average 500 large fruits per tree. This is equivalent to between 4 and 5 California boxes.

This area, like most other districts in Mexico, is now experiencing a planting boom. Present production, the exact amount of which is unknown, is said to be insufficient to cover requirements.

Jalisco. Oranges are produced in several parts of Jalisco, but the industry, commercially speaking, is located in several small valleys northeast of Lake Chapala. To the west of Guadalajara are a few plantings in *barrancas,* or canyons, but they are raised largely for local consumption. Very little of the fruit finds its way into Guadalajara or larger markets.

In the commercial areas, east and north of Guadalajara, are three concentrations of plantings: At Atotonilco el Alto, Ayo el Chico, and Degollado. In 1940 a census was made of these districts and the three valleys showed a total of 162,000 bearing trees.

TABLE 3.-*Number of orange trees in production in specified districts of Jalisco, 1940*

VARIETY	DISTRICT			
	ATOTONILCO EL ALTO	AYO EL CHICO	DEGOLLADO	TOTAL
	Number	*Number*	*Number*	*Number*
Navel	14,314	9,333	11,300	34,947
Escalon	55,456	15,035	3,302	73,793
Corriente (seedlings). .	12,643	34,371	6,256	53,270
Total	82,413	58,739	20,858	162,010

A survey of young and nonbearing trees was not included in the census, but producers in these areas estimate that the number of young trees for the three districts runs between 70,000 and 80,000.

Atotonilco is the most important of these districts. It is about 75 miles from Guadalajara and about the same distance from Zamora. Oranges from these valleys are referred to in other markets as Zamora oranges. As a matter of fact, few oranges are produced around Zamora itself. The Atotonilco el Alto Valley is about 18 miles long, but orange plantings are pretty much concentrated around the town of Atotonilco on an area about 2 miles wide and 4.5 miles long. The valley itself is a most interesting and beautiful one. If approached by the unimproved road running north of Lake Chapala from Guadalajara, it is like an oasis in a desert. From a high plateau the valley settles between the high ridges that protect it on three sides. The elevation of the mesas above is approximately 8,000 feet, whereas the floor of the valley is 5,200 feet. The northern end of the valley tapers to a dead end. At the center of the southern end an extinct cone-shaped volcano rises from the valley floor like a sentinel standing guard over the peaceful valley. The entire valley is shaped like a flatiron.

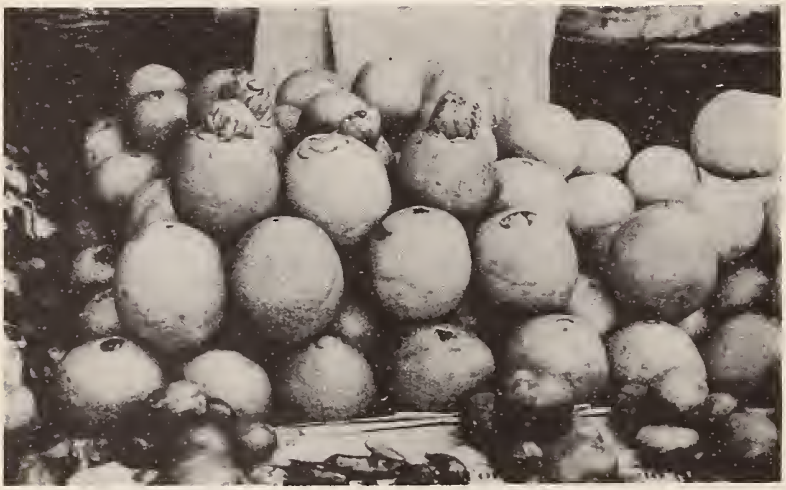


FIGURE 27.-Navel oranges from Atotonilco, Jalisco, of large size and showing pronounced navel development.

The orange plantings are mostly on the floor of the valley, but a few extend up the slopes to the irrigation ditch that supplies the valley with water. Fruit produced in this region is unlike that of any other district in Mexico. Though oranges in the Córdoba region take on a high color, the fruit from this district can be recognized anywhere because of its deep reddish-orange color. The cause of this unusually high coloring is not known. It is probably due to a combination of soil, climate, and exposure and may be partly the result of the reflection of light from the steep slopes of the nearby mountains. Prevailing winds from the south sweep through the canyons and are very strong during May and June, causing some scarring and loss of fruit.

Oranges have been grown in this area for about 200 years. Some of the present plantings are 50 years old and still bearing good crops. As far back as 1891 oranges from this district were exported to the United States.

A large number of the trees in this area are of the Corriente, or seedling type, but they are rapidly being replaced with known varieties. The navel was planted heavily some years ago but is not being increased. Though it flowers profusely, the drop is correspondingly heavy, and the tendency is toward shy bearing. The Escalon is said to be a variety of local origin. It has many of the characteristics, however, of the Valencia, and quite possibly it was introduced into the region from Spain as one of the Valencia types and its history forgotten.

Ayo el Chico and Degollado Valleys are similar to Atotonilco el Alto in character. Orange plantings in them could be expanded considerably, and nurseries are propagating thousands of seedlings that will be budded and sold as long as present prices hold and the demand for increased supplies continues.

About 300 carloads of oranges are shipped annually from Atotonilco, mostly by truck. The other two districts combined ship about an equal quantity, principally by rail. The improvement of roads and construction of new highways are greatly increasing the movement by truck. Growers prefer this method of transportation, for the trucker takes delivery of the fruit at the orchard and relieves them of having to deliver the oranges to the railroad. It is cheaper for the growers and eliminates certain handlings and thus insures better condition of the fruit on arrival, especially when it is sold in the Guadalajara and other nearby markets.

Production in these valleys, as in other regions, varies considerably according to variety, soil conditions, and practices followed by the individual operators. The average for all varieties is between 400 and 500 fruits per tree. The Escalon seems best adapted to the region and averages somewhat higher than this, and the navel averages less.

There are two distinct soil types in this region, one a heavy black sticky adobe that tends to bake, and the other a dark chocolate type that is more friable, better drained, and easier to work. The latter type predominates, and most of the plantings have been made on this type. The heavy black soil is largely given over to plantings of sugarcane, corn, and truck crops, especially tomatoes.

Trees of the same age planted on the heavy black soils are less than half the size of those planted on the chocolate type. In fact, 12-year-old trees on the former are not so large as 4- and 5-year-old trees in Valles, Montemorelos, and Córdoba. The quality of fruit produced on these heavy black soils is also insipid and dry.

Trees were first budded in this area on sour-orange stock. The union between stock and cion appeared to be congenial enough, but the root had a dwarfing effect upon the top. Trees made a small slow growth, and yields were low. Some years ago, one grower budded the desired varieties to grapefruit root. The trees responded

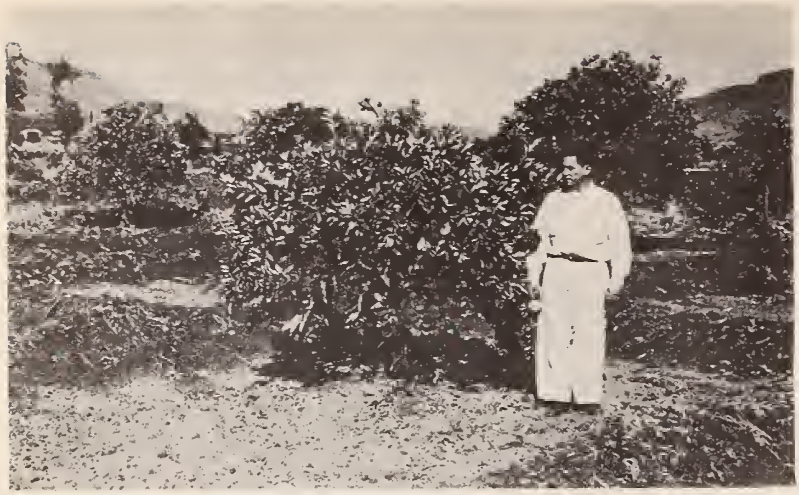


FIGURE 28.-Orange tree 9 years old and about the size of a normal 3-year-old tree. The heavy banking for flood irrigation will be observed.

rapidly, indicating the adaptability of the grapefruit root to local soil conditions. His 12-year-old trees are of good size, producing good crops, and apparently doing very well. Today all trees are being worked on grapefruit root.

Oranges are grown in many other areas but not in sufficient quantities to warrant a separate discussion. In general the varieties, habit of growth, cultural practices, marketing methods, etc., follow much the same pattern as those described. In some instances the trees consist largely of seedlings and are consumed locally, whereas in others a few commercial groves have been established in order to supply markets in nearby towns and villages.

Varieties

Regional Distribution. Mexican oranges are little known outside the country. They are not exported and therefore have no reputation to maintain. The domestic demand has kept fairly well abreast of supply, and there has been no particular consumer preferences or market pressure to bring about changes in the varieties produced or in the presentation of the fruit. The appearance of Mexican oranges compared with those from other sources is, on the whole, disappointing, and they would hardly measure up to the requirements of a discriminating or highly competitive market.

Appearance aside, one can say without fear of contradiction that the flavor, or eating quality, of oranges produced under average Mexican conditions is surprisingly good. From the standpoint of character and quantity of juice, size, shape, and color of the fruit, the product compares favorably with that produced in countries that enjoy an international reputation.

No concentrated effort has ever been made to standardize varieties or to bring about a general improvement in the industry through bud selection, improved strains, or even preferred market varieties. Up to the present no need has been apparent for any change, except, perhaps, to obtain higher productivity. The Mexican market is more particular about size and less discriminating as to appearance; consequently, the grower has had no incentive to attempt to improve the quality of his product.

Most of the oranges sold on the Mexican market at present are seedlings from the older established groves. Known varieties, however, are increasing rapidly and in a few years are expected to be available in larger proportion than the seedlings. The planting of budded trees of known parentage first received attention in one district about 1890 or 1895, but only a few growers gave it serious consideration. One grove in the State of Tamaulipas has a stand of Washington Navel trees planted between 50 and 60 years ago. The grower has practiced bud selection and the planting of improved strains. In other districts, commercial groves consisting of budded varieties were not established until about 20 years ago, and even then the practice was not general. In the heaviest producing districts from 50 to 70 percent of the crop consists of seedlings.

During recent years, however, especially the past 5 or 6 when interest in oranges first developed, the tendency to plant budded stock of known parentage has been strong. Many varieties, unknown to Mexico, have been introduced and given a trial. Some of them have responded well and are being set out in increased numbers; others have not done so well and have been, or are being, discarded.

Oranges produced under average Mexican conditions, whether of seedling or budded stock, have considerable merit. As is true in all countries, certain districts have advantages over others and some varieties do better than others. Navels, for example, in some sections grow to perfection and in others are inclined to be shy bearers and are considered unprofitable.

The peak harvesting season for seedlings is during November and December. Prices at that time are lowest because of the liberal supply. As the season progresses and supplies become less plentiful, prices advance. Toward the close of the season, March, April, and May, prices reach very attractive levels, and for this reason a keen interest has developed for midseason and late-maturing varieties, such as Parson Brown, improved Jaffa, Mediterranean Sweet, Valencia, and Lue Gim Gong.

In Nuevo León, varieties differ somewhat according to district. Around Allende the principal varieties are Parson Brown and San Miguel (St. Michael). In addition, the production of a native type known locally as Chinese is large. The Chinese stock has been grown in this area for many years and is supposed to have been introduced from Spain. Many of the seedling types have been developed from trees producing a superior fruit and budded to sour-orange stock.

In the Montemorelos district the principal varieties are Washington Navel, Parson Brown, Mediterranean Sweet, San Miguel, Valencia, and various varieties of blood oranges. A few Hamlins, Pineapples, and Jaffas are also grown but on a small scale. Parson Brown, a new type of Jaffa, and Mediterranean Sweet, are being produced for the midseason market, and considerable interest is being manifested in the Valencia for the late market.

The fruit sampled in different parts of Nuevo León was on the whole quite good. In all cases it had good juice content and good flavor. The juice, though plentiful, did not have quite the same body and character as that of oranges produced in the southern area of California. On the other hand, they are not so watery as the Florida oranges. They are, perhaps, most like the oranges grown in the Rio Grande Valley of Texas.

The fruit is uniform in size, seedlings, Pineapples, and blood oranges averaging from 176's to 200's. In the Allende area the Chinese variety averages about 200's in size and has a thin peel, large segments, large juice sacs, few seeds, and heavy juice content. The juice, however, is rather thin, watery, sweet, and lacking somewhat in character. Oranges from this area generally have a smooth bright skin, and, aside from mechanical injuries and a few other defects, are most attractive in appearance.

Tamaulipas is a small producing State. Seedlings, navels, a few blood oranges, and, in new plantings, Valencia Lates are grown.

The principal varieties produced in Veracruz are seedlings, navels, Valencias, Jaffas, and Murcia Bloods. In the Jalapa area, 70 percent of the oranges are seedlings, with Valencias, navels, and Jaffas making up the rest. Valencias seem to be well adapted to this region, and plantings have been fairly heavy during recent years. The selection of the varieties best adapted appears to be still in the experimental stage. Higher prices for the later maturing varieties is the principal incentive behind the increased interest in Valencias.

Around Córdoba, growers are enthusiastic over navel oranges, which do exceedingly well in this locality. The fruit attains good size, is very thin-skinned, and possesses an excellent flavor. Other varieties grown are Valencias, Murcia Bloods, and, of course, seedlings.

In Veracruz climatic conditions exert a considerable influence upon varietal characteristics. Navels, produced in the Córdoba district, are quite different from those produced around Jalapa. Fruit from Jalapa is fairly well colored, has a high juice content, but is inclined to be somewhat watery and lacking in character. The Córdoba area seems to be favored with a combination of factors conducive to perfection in the development of all fruits. The navel orange is especially well suited to this area. It attains good size, perhaps too large for some markets, but develops in accordance with Mexican requirements. It has an unusually thin skin, which adheres rather tightly to the segments - in fact, so much so that a part of the flesh is frequently pulled away with the peel, despite the fact that the fruit is very juicy. The segments are large, and the juice sacs are large and full of juice of unusually high flavor. Murcia Bloods are also of excellent quality. The fruit is of good size, well-colored, and attractive in appearance. It is heavy, and the juice is sweet and highly flavored. The blood characteristics have been more or less lost, but the flavor is much the same as that found in Murcias produced in Spain.

The oranges produced around Valles, San Luis Potosí, are attractive in appearance, especially the Washington Navel. They attain a good size, perhaps not so large as in some sections but averaging 150 to 176 per box. They have a fairly smooth skin, thin peel, and heavy juice content. Since pests are not serious, the fruit is generally clean. The color is good.

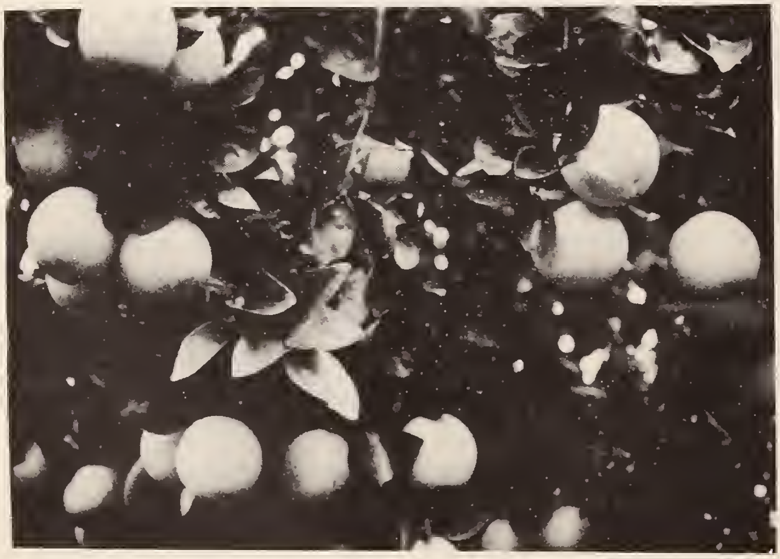


FIGURE 29.-Oranges produced near Valles.

In the Río Verde area at least 50 percent of the old trees are seedlings of various kinds. The remainder are navels, San Miguels, and Valencias. The young plantings, of which there are quite a number, are almost entirely Valencia Lates. This district also produces many mandarin oranges.

The quality of the oranges produced in tne Río Verde district is inferior to that of the fruit found in other districts visited. Not only are they less attractive in appearance; their eating quality is also less desirable. The fruit has a rather thick skin and is inclined to be rough and pebbly. The juice sacs are large, and the texture coarse. The flavor is quite good but more acid than in other districts. The fruit is juicy and in that respect it compares quite favorably with fruit from other areas. The markets, especially Mexico City, prefer fruit from Nuevo León to that from Río Verde, largely because of the coarseness of both skin and segments.

In the State of Jalisco about one-third of all the oranges are seedlings. Budded stock, however, is increasing in importance, and most young orchards are of trees of known parentage. The navel, planted heavily some years ago, is not proving altogether successful, and the present tendency is toward other varieties that show greater promise. The Escalon is claimed to be peculiar to this region, but has all the appearances of the Valencia. It is popular with growers and is being widely planted. Valencia Lates are also being planted to some extent, but they may not prove altogether satisfactory because of the heavy infestation of fruitfly during April, May, and June. Infestation after April is said to be especially heavy. Few seedling trees are being planted in this region.

The quality of the oranges produced in the Atotonilco and other commercial areas of Jalisco varies considerably according to location and soil type. Those produced on the best soils are sweet, full-flavored, and of fairly good juice content; those grown on the heavy black adobe soil are insipid, dry, and coarse in texture.

The Jalisco navel, which is produced in the valleys of Atotonilco, Ayo, and Degollado, commonly referred to on some markets as the Zamora Navel, possesses characteristics peculiar to this region. It is outstanding in shape and color. It is very long, almost oval in shape, similar to a Jaffa or Lue Gim Gong. In some orchards, the hilum shows little development, but in others it is prominent and overdeveloped. The skin is highly colored, sometimes a bright deep orange red. It is thick, in distinct contrast to that of Veracruz navels, which is unusually thin. The skin adheres tightly to the segments, especially toward the navel or blossom end. The locules are difficult to separate, often tearing apart. When produced on

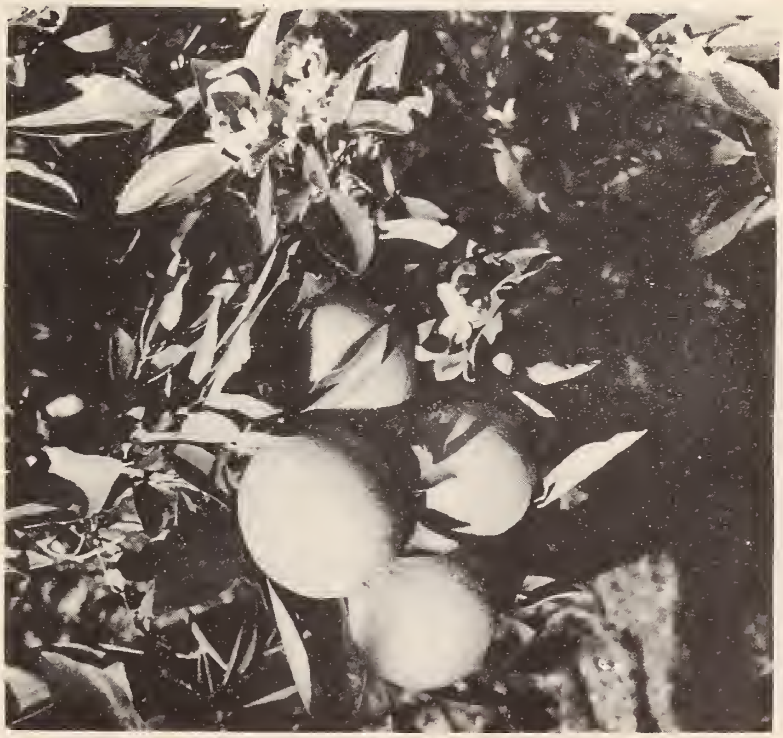


FIGURE 30.-Jalisco navel oranges.

the chocolate loamier soils, the fruit is juicy, sweet, and pleasant in flavor. That produced on the heavy black sticky soils is dry and insipid.

The Escalon is a very attractive orange but inclined to be less round than the Valencia under California conditions. It has good color, is firm, and is in demand because of its good shipping and keeping qualities. It has numerous seeds, however, averaging 15 to 20. The rind is fairly thick and separates easily from the segments. The fruit is juicy and has a pleasant flavor. The Escalon is increasing in importance, being popular with both growers and consumers.

The trees in this area are not so large and do not grow so rapidly as in the other districts mentioned. They are compact, however, and more ball-shaped in appearance. The trees are vigorous in appearance and, though slow of growth, have a good healthy dark color.

Nurseries and Nursery Practices

There are few nurseries in Mexico that specialize in growing citrus trees for strictly commercial purposes. Most growers propagate their own stock, selling or giving away the surplus to other growers.

The nurseries are usually located in some favorable spot in a young orchard, the seedlings or young budded trees being planted between the permanent trees or in a small gardenlike plot near the farmhouse. The seeds are planted in rows about 12 to 18 inches apart, and after they have made about a year's growth they are budded or set out. Frequently seedling trees are set out as permanents and budded to the desired variety after they have become established.

Little attention has been paid to the selection of buds from superior trees of known parentage and high productivity. Since oranges are produced rather abundantly in a more or less wild state, the commercial plantings are considered a great improvement over the older orchards. A few recognize the importance of bud-selected trees and the use of proper rootstocks, but such attention is by no means general.

Sweet orange is perhaps the most widely used rootstock, although seedling trees, as the name indicates, are on their own root. Sometimes budding is done on sour-orange stock. In the heavier, poorly drained soils, the sour orange has been found less desirable than the sweet orange or grapefruit. In Atotonilco, where the soil is very heavy, grapefruit has proved to be the most satisfactory rootstock.

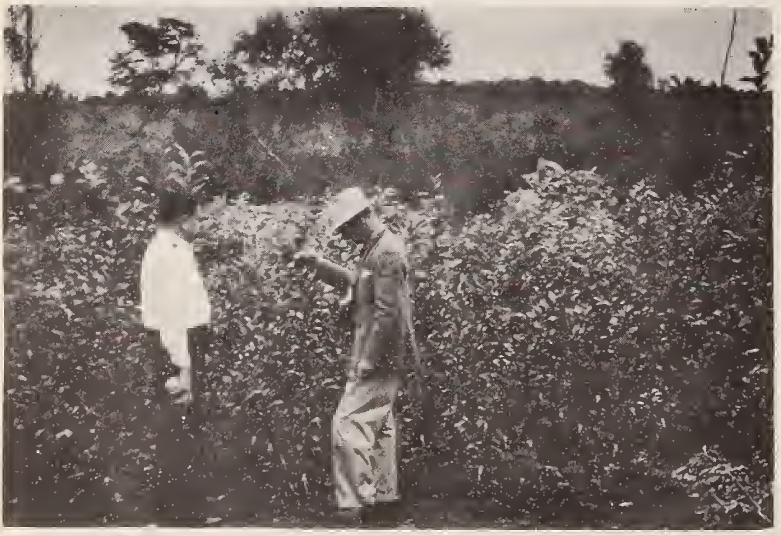


FIGURE 31.-A planting of young orange trees in the nursery row.

Budding is done during both the spring and the fall months. In most districts the usual method is to insert shield buds in inverted T-shaped incisions, but in the Jalapa district in Veracruz growers claim to have better results by using the patch-bud method.

In the United States, much emphasis has been placed upon systematic bud selection and progeny propagation, but in Mexico little or no attention has been given to this practice. Conditions as yet have not made such advanced methods necessary. Nursery trees are not trained and staked but are allowed to develop more or less naturally. The selection of stock is not an exacting procedure, and most growers are not particular about the size and vigor of the trees planted.

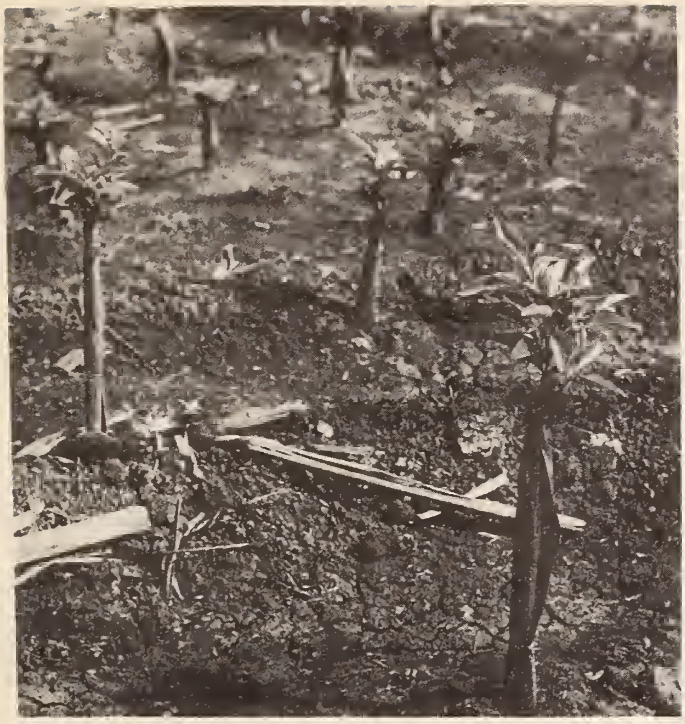


FIGURE 32.-Young nursery trees with trunks protected, at Río Verde, San Luis Potosí.

Cultural Practices

Cultivation. The cultivation of oranges in Mexico varies considerably from one district to another. The practices followed are governed largely by type of soil, climatic conditions, topography of the land, and local customs. With few exceptions the trees receive cultivation in some form. In some cases the land is plowed, disked, and harrowed, and kept in excellent condition. In other instances it is plowed only occasionally and left more or less rough and open. Under certain conditions it is impossible to get over the land with plows and machinery, and any tillage done is by hand. In general the groves are well cared for, and there are only a few indications of neglect or careless handling of the soil.

Throughout the State of Nuevo León the groves are unusually well looked after. Clean cultivation, supplemented by some cover cropping, is the accepted practice. On some of the larger holdings, power-drawn equipment is used

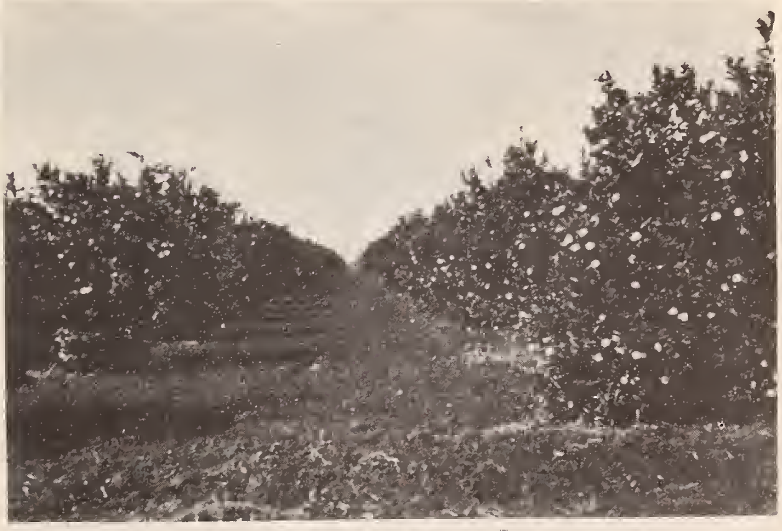


FIGURE 33.-A typical orange grove between Montemorelos and General Teran, showing clean cultivation.

and the appearance of these groves compares favorably with that of the well-cared-for groves in the United States. Although most of the plantings are small and the land is cultivated by mules and horses, the work is well done and the groves make a presentable appearance. Cultivation of the groves around Montemorelos and the newer developments between Montemorelos and General Teran is especially good and creates a splendid impression of the care exercised in the handling of the soil. A grove showing indications of neglect in this area is rare. Where the land is flat and easily worked, clean cultivation is more or less continuous, and the accepted practice; but on the more hilly ground, where soil erosion is a problem, clean tillage is supplemented with cover cropping.

Although oranges have been produced in the State of Tamaulipas for many years, the cultural practices there are hardly to be compared with those in Nuevo León.

The newer plantings receive fairly good attention, but the older groves are unkempt in appearance and show signs of neglect. In some orchards the trees are carrying dead wood, and the ground is covered with dead weeds and brush. The general tendency in this area is to turn under cover crops and to practice less clean cultivation.

In the State of San Luis Potosí clean cultivation is the accepted practice, coupled with considerable intercropping and some cover cropping. In the Río Verde district the groves are usually clean-cultivated; and, though weeds are used to some extent as a cover crop, manure is largely depended upon to keep up the physical and chemical properties of the soil.

In Veracruz heavy intercropping is an established system. In both Jalapa and Córdoba the land is mostly hilly and steep. Rainfall is abundant, and clean cultivation, or even much cultivation, would be impossible as well as harmful. In the Jalapa area the land was originally covered with a dense growth of trees, shrubs, and vines. This was cleared and the land planted to coffee and chalahuite, a tree used to shade coffee. On the original coffee plantations, all the available space was planted to coffee and the trees used for shade. In the later plantings, however, bananas and oranges were planted between the coffee trees. This practice prevails today.

Many of the plantings are on steep rough land, strewn with lava, frequently in the form of huge boulders. This is ideal coffee land and is equally suited to bananas and oranges, which are planted at the same time the young coffee trees are set out. Bananas are used to shade the young coffee trees and, at the same time, to bring in some early returns. While the citrus trees are reaching full maturity, the coffee trees are producing revenue. When the

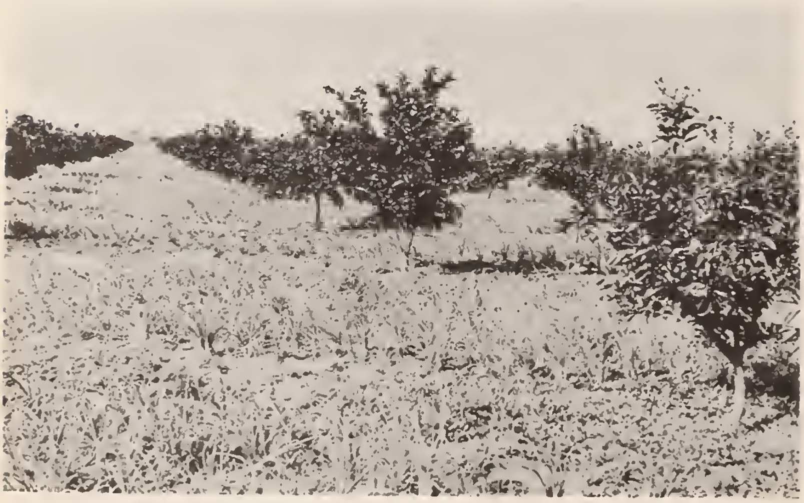


FIGURE 34.-Young orange grove showing interplanting of onions, Río Verde, San Luis Potosí.

latter begin to interfere seriously, they are removed and a permanent stand of orange trees remains. On some plantations both orange and coffee trees are kept permanently. The orange trees produce the necessary shade for the coffee, and returns are derived from both crops. When oranges are interplanted with coffee, the trees are headed much higher than when they are set out alone. Shade is thus provided for the coffee without interfering with its natural development or with the conformation of the coffee tree, and a certain amount of air circulation is permitted to the orange tree, which reduces the percentage of soft and decayed fruit on the lower limbs and branches.

When the chalahuite tree is grown for shade, it is planted at regular intervals throughout the coffee plantation. It is slender and grows quite tall. The bottom limbs are removed, and the top ones spread out in a fan shape to form a canopy or umbrella over the coffee. From a distance the trees resemble a natural forest growth, and one would never suspect that the area was given over to a cultivated crop.

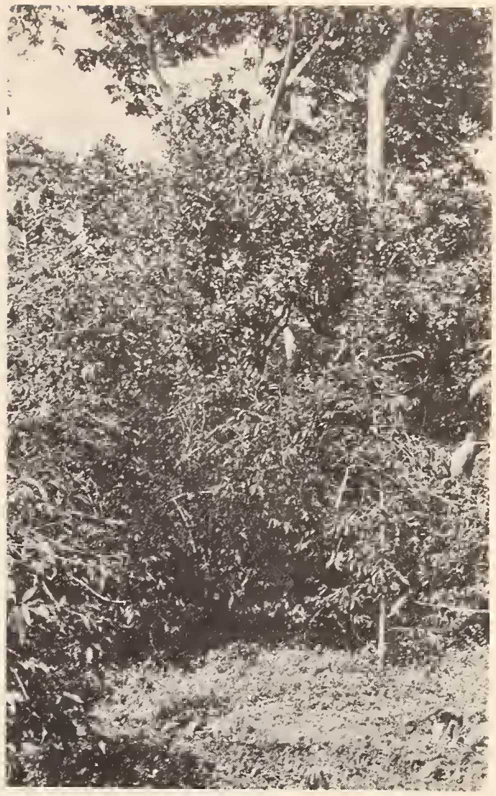


FIGURE 35.-Mixed planting at Cuatepec; high shade trees, high-headed orange trees, and coffee.

The heavy tropical downpours that occur in this area, together with the heat and humidity, result in a dense, rapidly growing cover of vegetation. The problem is not to make things grow but rather to keep the jungle from encroaching upon the cultivated fields.

Weeds, grasses, tradescantia, and other creeping ground covers grow luxuriantly and are used as green-manure crops. They are kept under control by hoeing. A heavy, wide-bladed implement, known as an Arabian hoe, is the tool most commonly used. It simply scrapes the surface of the soil, cutting the weeds and grasses at the crown. Care is taken not to dig into or loosen the topsoil, for this would only result in erosion and the loss of good topsoil. These crops are allowed to remain on the surface and act as a mulch for the trees. Where the land is not too steep and rugged and plowing can be performed, the implement used is known as an Egyptian plow. It consists of a wooden stick with an iron point. Because of carpet grass this plow is considered the most satisfactory type of implement, since it digs in under the roots of the plant, pulls it up, and exposes the roots to sun and air. If carpet grass is cropped, it becomes more dense and hence more difficult to control. If it is allowed to grow naturally, the weeds and other erect-growing plants will eventually shade it out.

Land that is given over entirely to the production of oranges is generally in good cultural condition. Such plantings, however, are few and far between, though oranges are gradually replacing coffee. On the whole, areas planted to citrus would not be recognized as such, since the hillsides seem to have a natural covering of tropical growth.

Orange trees, even when planted by themselves, are headed higher than they are in other producing districts. This is because of the heavy rains and the high humidity. High heading, again, provides better circulation of air around and under the tree and reduces the percentage of decay.

In the Córdoba area many orchards are planted on land less rugged and rocky than that around Jalapa. Where the land is not too steep and the danger of washing and erosion is less, the tendency is toward more cultivation. In some orchards, the custom is to work around the trees, leaving the middle undisturbed, except for cutting or scraping with a hoe.

In Jalisco, though most of the orchards are on fairly level land or on gentle slopes, little cultivation is practiced. The soil is heavy and rather difficult to handle; consequently plowing is reduced to a minimum and confined largely to running furrows and banks for irrigation.

Cultivation consists largely of keeping down weeds by hand with the use of a curved, bladed instrument.

No cover crops and no intercrops are planted; in fact, planting distances are too close for such crops to succeed.

Fertilization. The use of fertilizers, like other cultural practices, varies considerably, not only between districts, but with the individual planter. Barnyard manure is used almost entirely by some; other growers are turning to commercial fertilizers, or a combination of both. Green-manure crops in some localities are relied upon altogether for maintaining the fertility and good physical condition of the soil.

In Nuevo León most growers use fertilizer in some form. Manure, which was formerly used entirely, is being replaced to some extent by commercial fertilizer. Some growers use nitrate only, whereas others use a complete mixture in the proportions of 8-6-10 and 8-6-11.

In the Montemorelos area growers are using approximately 100 tons of nitrate of soda in addition to the complete mixture and stable manure.

In Tamaulipas growers depend largely upon cover or green-manure crops as their chief source of fertilizer. This in some orchards appears to be sufficient, but in others the trees would undoubtedly be benefited by the use of some quick-acting fertilizer.

In the Río Verde district of San Luis Potosí it is customary to fertilize the land heavily. Animal manure is shipped in by the carload and is applied at the rate of 6 to 8 tons per acre. There are two reasons for such heavy applications: The high mineral content of the irrigation water and the intensive intercropping. Tomatoes, garlic, onions, and peanuts are planted between tree rows in young orchards and require additional fertilizer. In the older orchards water is used liberally, and heavy applications of manure are considered essential to counteract the effects of the high lime content upon the soil. The soil in this area, generally speaking, is loose and friable.

Oranges produced in tropical areas like Veracruz seem generally to thrive without commercial fertilizers. Where barnyard manure is available, it is used; otherwise growers depend upon the cover crops that decompose slowly and act as a mulch, or they turn under various natural covers where the topography of the land permits. In one excellent grove visited near Córdoba, the owner uses such refuse as is found in any city dump. A large trench about 3 feet wide and 2 feet deep is dug through the center of every two or three rows of trees. The trench is then filled about half full of refuse, covered with lime, and refilled with dirt. The refuse decomposes slowly and supplies a source of food upon which the trees can draw for a period of several years. The part of the grove that had been so treated showed a very beneficial effect from this treatment. The trees were large, vigorous, and healthy in appearance and were bearing splendid crops of fine large oranges.

In the commercial areas of Jalisco most orchards receive some fertilization. Animal manure is preferred to commercial forms, and growers use as much of this as is obtainable. Where sufficient barnyard manure is unavailable, a complete fertilizer is used. The following mixture is the one most commonly used: 2.2 pounds of nitrate of soda or sulfate of ammonia, 3 pounds of superphosphate, and 1 pound of potassium sulfate. In heavy orchards it is applied at the rate of 1.1 pounds per tree three times a year, or a total of 3.3 pounds.

Irrigation. Though oranges are produced in some parts of Mexico without irrigation, most of the commercial districts are dependent upon some source of water supply in addition to natural rainfall.

In Nuevo León annual precipitation averages 24 inches a year, but this frequently is insufficient to supply the requirements of a full-grown bearing orchard. Citrus trees require soil moisture at all times, but during certain periods their demand for moisture is much heavier than in others. Some years rainfall is sufficient to carry the crop through, but in years of low rainfall or protracted periods of drought irrigation must be resorted to in order to keep the trees from suffering serious damage. All the older orchards in this district are under irrigation, but a large part of the young plantings are on dry land. The rains come during June-July and September-October, and whether the moisture during these periods will be sufficient to carry the young orchards through is for the future to decide.

In the Río Verde area the average rainfall is about 21 inches. The supply of irrigation water is ample, however. It comes from a large spring and from the Río Verde. The irrigation system was originally developed by the owners of the large haciendas. They built the canals to carry the water to their fields. The present owners pay 2 pesos per hectare per year (16.5 cents an acre) for the water. Actually no charge is made for the water itself, this assessment being in the nature of a service charge used to defray maintenance costs, such as repairs to canals and ditches.

In the districts of commercial production in Jalisco water is sufficient to take care of immediate requirements. In the Atotonilco Valley it comes from a large spring.

Most of the irrigation water in Mexico is carried in open ditches. Many old aqueducts, dating from colonial times, have fallen into disuse. They were built of brick and tile and, though inadequate for present usage, were more conservative of water than the open ditches. Occasionally orchards are irrigated by diverting the water into furrows plowed between tree rows, but the flood, or basin, system is more often used.

Despite the fact that a large part of Mexican agriculture is dependent upon irrigation, the tendency in most areas where water is available is to be wasteful. Water is frequently seen running across cactus-covered land or down roads, with no attempt being made to repair the breaks in the ditches. Though trees in some orchards suffer for lack of water, generally where it is more or less plentiful, farmers are likely to overirrigate.

Insect-Pest and Disease Control. The usual pests common to most citrus-producing areas are prevalent in Mexico. Generally, however, their presence has not reached serious proportions, at least not to the extent that the loss of either grove or market is threatened. The need for a better control program is generally recognized, but it is left to the occasional grower to organize.

For the country as a whole, scale insects, Mexican fruitfly, red spider, aphid, and rust mite are the most common pests. Of the diseases, foot rot, scaly bark, anthracnose, and melanose are of first importance.

In Nuevo León growers do not consider pest control a serious problem, but those who do attempt to carry out some form of program contend that price returns on oranges are sufficiently good to warrant the expenditure of 50 to 100 pesos per hectare ($4 to $8 per acre) for that purpose. Most growers do not spray at all, but those who do use oil emulsion for summer sprays and lime-sulfur for winter applications. The pests considered of importance in this area are red scale, fruitfly, and red spider. In some of the older orchards rust mite is giving considerable trouble, and in others growers are having difficulty with melanose.

The majority of growers in the Allende-Montemorelos area have very small holdings and cannot afford to purchase the necessary equipment for spraying. No serious thought has been given to custom spraying or to the purchasing of equipment on a cooperative basis. Where spraying is done at all, the average is one application.

Little spraying is done in Tamaulipas. Red spider and rust mite are more serious than fruitfly, although Valencias, especially the late pickings, are frequently heavily infested with fruitfly.

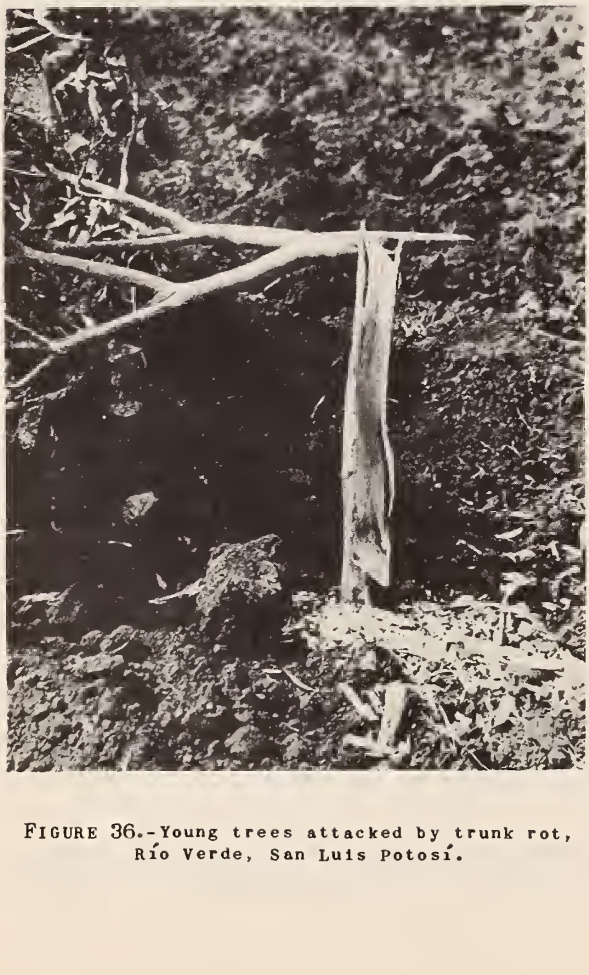


FIGURE 36.-Young trees attacked by trunk rot, Río Verde, San Luis Potosí.

In the Río Verde Valley, San Luis Potosí, most pests and diseases common to citrus are prevalent. Scale insects, red, black, and purple, are quite a problem in some orchards but on the whole are not causing a great deal of damage. In some instances the purple scale is, however, creating quite a problem. Rust mites and scale crawlers are serious in some orchards. Melanose is also a problem, and black fungus is causing some injury. Foot rot and scaly bark are perhaps the worst diseases in the area. They attack old and young trees alike; and, though surgery is practiced and wound dressings applied, control is not satisfactory. Only the outer shells of some trees remain. Many young trees were observed to be completely girdled and killed.

Navels are especially susceptible to canker, and for that reason their planting is being discouraged. Valencias, apparently, are free from this disease and are being planted more heavily.

A few growers in this district do some spraying, but most of them do not spray at all. The usual schedule is three applications of Bordeau mixture.

In Veracruz spraying is not an accepted practice. A few large growers have equipment and apply three or four coverages. One grower uses a duster. Most of the smaller growers have neither the equipment nor the inclination for spraying. Common scale insects and aphids, with resultant sooty mold, rust mites, and thrips are said to be the most troublesome in this area.

In Jalisco the fruitfly is considered of first importance. This insect causes much damage, infestation being especially heavy during April, May, and June. After April the fruit is heavily infested with larvae and presents a real problem for late-maturing varieties.

Some scale is present, but it is not serious, and few growers do anything about it. The aphid frequently becomes quite a problem especially on young trees. About the only spray used is nicotine sulfate. Few growers have spraying equipment, and only the larger growers make any attempt to spray.

There is some gummosis present, but no effort is made to control it.

Harvesting Period. Oranges in Mexico are available throughout the year, but the principal shipping season extends from October through May. In some districts the heaviest shipping season is during December, January, and February. In Nuevo León shipments begin around November 15, finishing in May. The peak movement is in January. Difficulty is frequently experienced in getting sufficient cars to move the fruit during the height of the season. By May the fruit begins to get soft and difficult to handle.

In Veracruz the picking season extends from October to April, with the peak movement, largely of seedlings, in November.

In the Río Verde district in San Luis Potosí, harvesting begins with seedlings in November, but they are still immature at that time and do not reach their best until December. The harvesting of seedlings continues through February. The main part of the navel crop is harvested in November and December, although some fruits are allowed to hang as late as the end of February. The Valencia harvest reaches its peak in March, and in recent years the planting of this variety has been increased in order to extend the marketing season.

In Jalisco the harvesting season begins in October with seedlings and finishes in March with navels. The Escalon is picked during February and March. Some Valencias are being planted for late marketing; but, because of heavy fly infestation during April, May, and June, it is doubtful whether late-maturing varieties will prove profitable. There is a tendency in some areas to begin harvesting operations while the fruit is still immature and in other districts to delay it as long as possible in order to take advantage of advancing prices. In general, however, the bulk of fruit is marketed in its proper season.

Standards of Maturity. Mexico has no legal standards of maturity, either State or Federal, and each grower begins the harvest whenever the outward appearance of the oranges indicates approaching maturity. Chemical tests for determining the solid-acid ratio are ignored. Early in the season a certain amount of unpalatable fruit is sold on the market, but no measures have been adopted and none seem to be contemplated to correct this practice.

The color-added process, or degreening treatment, is unnecessary under average Mexican conditions. When the fruit is sufficiently ripe to eat and mature enough to pass the standards used in the United States, it has also obtained a good orange color. In fact, oranges in some districts are so highly colored that they appear to have been dipped in a coloring bath in which too much red was added to the solution.

Grades and Standards

No attempt has been made in Mexico to set up grades and standards upon which to base selection or classification of oranges. Grading, after a fashion, is carried out but not on any well-defined basis, and more upon size than quality. Most of the fruit in the country is sold at so many pesos per thousand units at the orchard. Such sizing, or grading, as is done is at the time the fruit is counted out and dumped into the buyer's truck. Fruit is generally divided into two grades, Good and Poor. The top grade contains the largest sized fruit, 200's and larger, which are fairly smooth and clean. The term "Poor" is quite descriptive of the No. 2 grade. It includes fruit having thick, coarse, rough-textured skins, broken skins, or large parts of the peel pulled out at the button; heavily scarred or stained fruit; and specimens too liberally infested with scale insects. No. 2 grade also includes fruit smaller than 200's.

Large oranges are worth about 50 percent more than the small ones. Since the market demand runs strongly in favor of large fruit, to interest buyers in the smaller sizes is difficult. Fortunately, the percentage of the crop running to the smaller sizes is usually small. The No. 2 grade is discounted about 40 percent from Good grade. The sizing is all done by hand, and buyers are not strict about a few of the smaller fruits getting in. In fact, the selection and methods of trading between buyer and seller are pretty well understood in advance.

In some districts, no great effort is made to grade the fruit, as the grower contends that the market is not very discriminating and is not willing to pay a premium for properly selected fruit. In Veracruz, for example, grading is largely a question of sizing. The very worst specimens are discarded, but ordinarily everything of a certain size is included. Here, again, fruit is not sized according to actual dimension but sorted into three general classifications, small, medium, and large.

Fruit shipped from the Río Verde district is sorted into two grades for the wholesale market. The first grade consists of large, fairly clean fruit, and the second of small, dirty, badly blemished oranges, as well as those with broken skins. At the retail markets, the grades are broken down into several additional grades, mainly on the basis of size.

Harvesting Operations and Packing

The harvesting and handling of citrus fruits have become highly specialized procedures in most commercial producing countries. In Mexico, however, the accepted practices generally used throughout the world in preparing fruit for market are unknown. Careful handling is totally disregarded, and one is amazed under these circumstances that any fruit reaches its destination in merchantable condition. Fortunately, the fruit is all sold locally and does not have to travel great distances. Because of poor transportation facilities, however, several days often elapse between the time the fruit is harvested and the time it is placed on the market. Growers and shippers in most countries have learned that soundness and good keeping quality are of fundamental importance in the successful marketing of any perishable crop. But the handling of fruit in Mexico from picking through loading, unloading, and handling at destination is not what it should be. Oranges can be subjected to a certain amount of abuse and not show it immediately, but there is a limit to the amount they can stand.

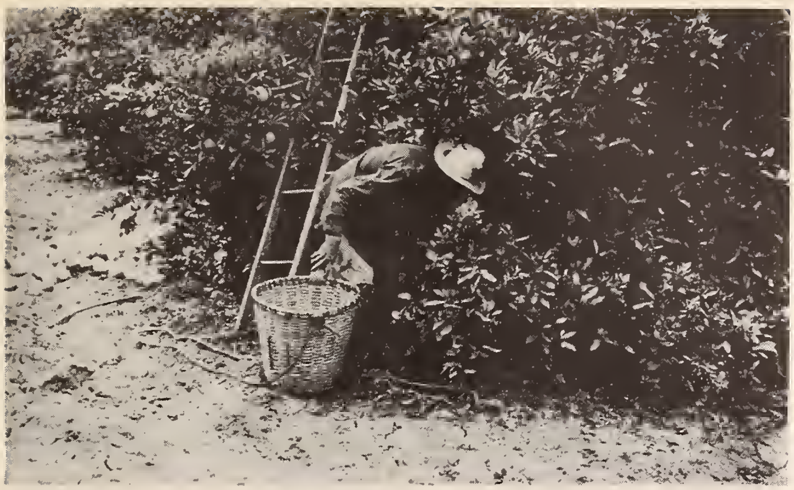


FIGURE 37.-Picking oranges.

Since the Mexican markets are not so exacting as those in most countries, the need is less for the elaborate preparations that growers in other countries have been forced to adopt. Since fruit is highly perishable, however, some improvement in handling methods, without necessarily increasing expenses, could be adopted to great advantage.

Picking. Oranges are pulled from the trees, not removed by clippers. Generally pickers work for a daily wage, but occasionally they are paid on a piece-work basis. There seems to be little difference between the two methods insofar as rough handling is concerned. The practice of pulling the fruit results in considerable injury, with many oranges having torn or plugged skins. Fruits so damaged are sold as Poor, or No. 2 grade, and bring from 30 to 50 percent less than sound fruit.

Trees are not "spot picked" for size or color. When the harvesting season for a particular variety arrives and prices are considered satisfactory, all fruit that appears to be ready for the market is removed. In older groves both straight ladders and stepladders are used, and not much care is exercised by the pickers in placing the ladders. Large wicker baskets, each holding about a bushel and a half of oranges, are used. Frequently a long rope is attached to a basket so that it can be dragged or drawn up into the tree.

The fruit, after being pulled from the tree, is thrown into the picking container. When the container is full or too heavy to drag around, the fruit is dumped into a pile in the center of the tree row. Piles of fruit are built up throughout the orchard, each pile containing the harvest of several neighboring trees. The fruit is sold largely in the field, the buyer furnishing transportation. He comes to the orchard with truck or cart and loads the oranges. The selection and count are made here. The oranges are placed in the same

FIGURE 38.-Oranges piled between rows of trees.

type of basket that is used for picking. Since they are sold on the basis of thousand units, they are counted as they are thrown into the baskets.

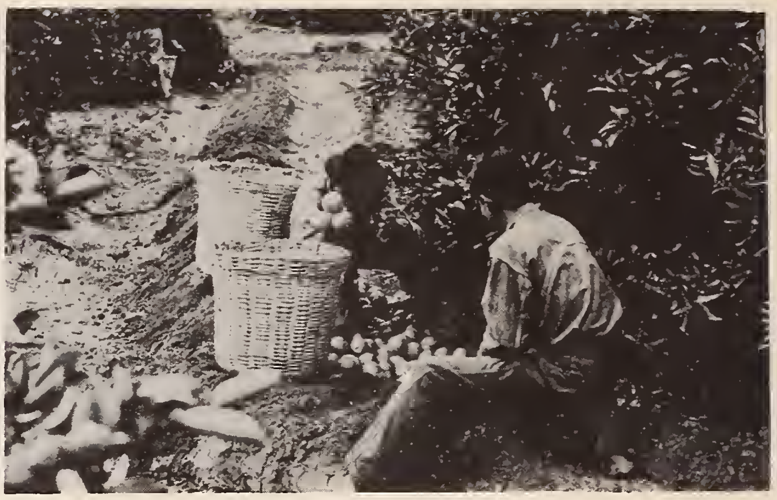


FIGURE 39.-Gathering up the oranges in baskets.

Packing. At present no packing houses, storages, or processing plants are in the producing area. In Veracruz only did the writers see oranges graded, the surface dirt removed, and the fruit packed in boxes. The work was being done on a small scale, but the owners were well paid for their efforts. The fruit was sized by hand, wiped with cloths, and packed unwrapped in small boxes weighing 40 pounds and containing from 36 to 45 oranges.

Packing oranges in closed containers is unknown in Mexico. Limes for shipment to the United States and mandarins that are marketed within Mexico are packaged, but oranges are shipped in bulk. In only a few instances has any attempt been made to box fruit, and only on a small scale. Mandarins are packed in boxes weighing 70 pounds gross. A slatted-box crate, used for shipping tomatoes, is the accepted type of package. The fruit is place-packed, unwrapped, and makes quite a presentable appearance. The slats cause considerable cutting of the fruit, however. This apparently is not considered a serious fault, since no attempt is made to correct it.

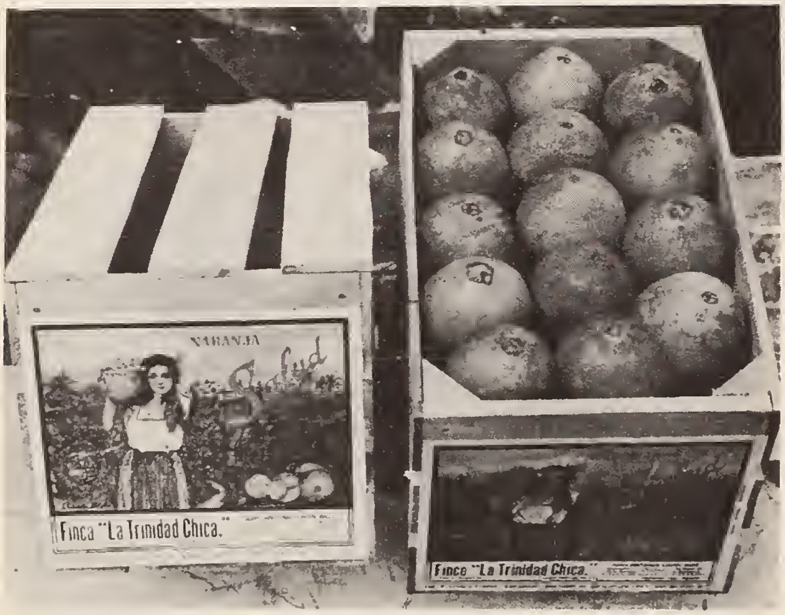


FIGURE 40.-Box used for oranges and packed box of a grower at Fortín, Veracruz. As far as can be ascertained this is the only packing of oranges done in Mexico.

Practices long recognized as indispensable to the citrus industry in most countries, such as washing, drying, polishing, and packaging, are disregarded in Mexico. Since small-sized fruit is heavily discounted, some attempt is made at sizing. This operation, however, is done by the eye, and only the smallest fruits are removed. The percentage of small sizes is

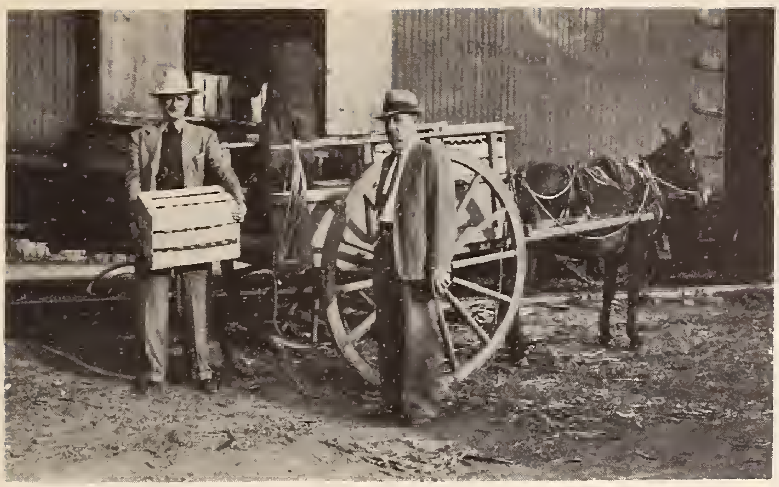


FIGURE 41.-Loading boxes of mandarin oranges.

insignificant. Mechanical sizers are used to some extent in sizing limes for shipment to markets in the United States, but for oranges, mandarins, and other citrus fruits, there is no record of any sizing machine in operation.

As the supply of oranges increases and competition for existing markets becomes keener, some improvement in handling methods possibly will be necessary. On the other hand, as prices decline many growers may show even less care and attempt to offset the lower prices by reducing costs, though in most areas one would find it difficult to lower costs.

Oranges are not exported, but, should the time arrive when overseas markets or export outlets become necessary, some drastic changes in both harvesting and handling methods would have to be adopted.

Hauling. When the baskets are full, the oranges are dumped into the bed of the truck or cart. No padding or protection of any kind is provided to cushion the fruit from bruising or injury through contact with the sides or bed of the truck. The fruit is dumped over the side, dropping the height of the side boards. A heavy plank with crosspieces nailed on it is sometimes placed against the truck for the men to ascend. The baskets are then carried on their shoulders and the fruit dumped from that position, dropping some 5 or 6 feet. The carts usually have a piece of matting or sacking spread across the bottom and along the sides for protection. It does little, however, to break the fall or minimize the rough treatment. If shipment is by rail, the fruit is hauled to the railroad yards, where it undergoes two or three more rough handlings. The picking basket is placed on the ground, a hole punched in the matting or sacking, and the oranges allowed to pour through the opening like coal through a chute. Rail shipments are also made in bulk; therefore the oranges are again dumped, usually into a cattle car.

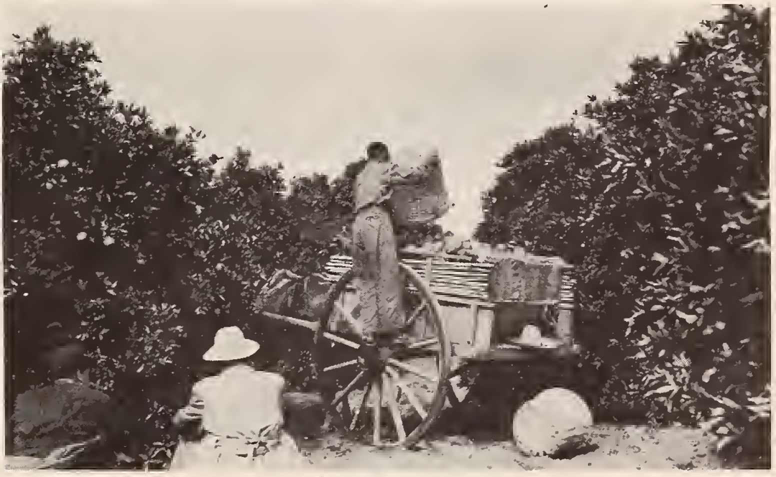


FIGURE 42.-Men loading oranges in the orchard.

A car holds from 60,000 to 70,000 oranges, sometimes as high as 80,000. When the car is loaded, boards and wire netting are nailed across the door, and it is ready to roll to market. Oranges are sometimes hauled from the small piles made in the orchard and dumped into one big pile in a shed with open sides and a rooflike covering. No picking bags, field boxes, packing sheds, grading and washing machines, or any other type of equipment, are considered necessary or provided.

Refrigeration. Precooling, refrigerator cars, and cold storage have not yet become a part of the Mexican fruit industry. Except in the shipment of limes, which are grown for export, the need for these facilities has not made itself apparent.

While oranges usually keep better if left hanging on the tree, the marketing period in Mexico could be extended if fruit susceptible to severe fruitfly infestations could be removed before they were attacked and held over in cold storage. The best cold-storage plants in Mexico are said to be those owned and operated by the breweries. A room, or space, is frequently rented out when available, but there are no storages designed or constructed primarily for fruit.

Mexico City has several cold storages in which fruit is held for short periods, but conditions are not considered sufficiently satisfactory to warrant the risk of holding supplies on a long-time or seasonal basis. Importers of United States fruit, for example, while they purchase their seasonal requirements well in advance of the shipping season, prefer to have the goods stored in the United States and withdrawn and shipped as it is needed. Upon arrival in Mexico City the fruit is placed in rented rooms and withdrawn a few boxes at a time. While storage facilities have improved considerably in recent years, much is still to be done before they can be considered safe for storing fruit over long periods. Until recently the brine-type cooling system was used entirely, but in the last few years there has been a gradual conversion to circulating air. Importers who have used local storage plants in the past have had some rather costly experiences because of poor equipment, break-down of

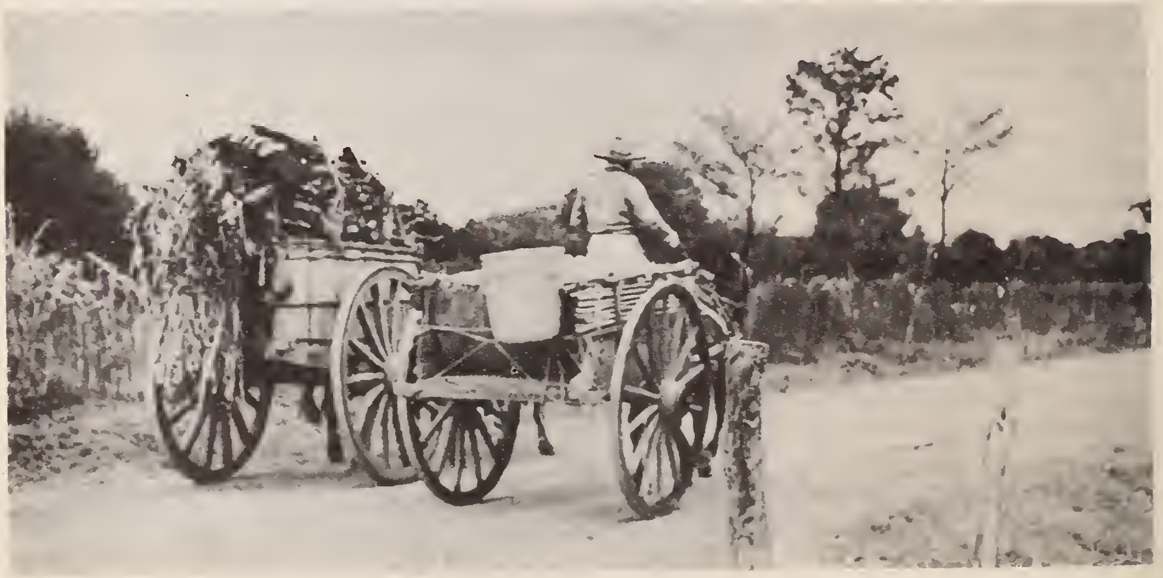


FIGURE 43.-Oranges on the road to railway car.

machinery, fluctuation of temperatures, etc. Cold-storage costs run about 4.50 pesos per cubic meter (2.6 cents per cubic foot) per month, or about 40 centavos (8.2 cents) per box per month.

FIGURE 44.-Unloading oranges from cart.

Costs of Production

Detailed or itemized growing costs in Mexico are unknown. The question of costs was raised repeatedly by the writers in all sections visited, but in no instance could a grower give a definite estimate. No records are kept, and growers know in a general way only if they are making or losing money on a crop.

In Nuevo León the cost of the tree, planting, and first irrigation is estimated at about 1 peso per tree (about 21 cents). From planting time until the trees are 5 years of age, the cost is roughly estimated to be at about 5 pesos per tree. This does not include fertilizer or spray. One grower estimated his costs at from 1,300 to 1,400 pesos per hectare ($108 to $117 per acre), exclusive of interest on the investment, fertilizers, and spray material. Another grower estimated that the costs of an orchard for the first 10 years amounted to 2,000 pesos per hectare (about $167 per acre).

A grower in the State of Tamaulipas has estimated his costs of production at about 3 pesos per box ($0.62). In view of labor costs, cultural methods practiced, and lack of capital investment in harvesting and packing equipment, this estimate is very high. The cost of producing 500 units, which is considered an average yield, was figured at from 7 to 8 pesos. One grower estimated his costs, including all charges, such as interest and growing, harvesting, and sorting costs, at about 15 pesos per 500 fruits, which is equivalent to a dollar or more a box.

The average yield per hectare of orchards 10 years old or older is estimated to be 75,000 fruits, or 500 oranges per tree.

FIGURE 45.-Oranges loaded in car.

On the basis of the selling price of 15 to 20 pesos per thousand, they are making a good profit, perhaps as much as 50 percent over and above growing costs.

The average wage scale for labor in 1942 was 1.50 pesos per day for 8 hours' work. Pickers received 50 centavos per thousand. Some pickers harvest 15,000 or more oranges in 8 hours, or four men nearly a carload a day. Sorting cost 6 pesos per car. Wages, however, increased substantially during 1943.

Prices Paid to Growers

The selling price of oranges varies according to variety and season and ranges all the way from 10 to 50 pesos per thousand. In Nuevo León the range is from 10 to 40, with an average for the season of about 15. In Veracruz prices average somewhat higher, and in the Río Verde district the average is a bit less. At the first of the season prices are usually about 10 pesos, but they increase as the season advances. At the close of the shipping season values are up to 35, 40, or even 50 pesos per thousand. Prices appreciate a peso every 2 weeks until after February, when they increase at the rate of some 5 pesos a week. Sales are most active when ruling prices are from 15 to 20 pesos.

The peak shipping season for most districts extends from December through February. The seedling types, which are in heaviest supply, move during this period and bring the lowest prices. In the Allende-Montemorelos district the heaviest movement is in January, and prices paid at that time average about 14 pesos. Valencia Lates bring the best prices, usually 35 to 40 pesos per thousand.

In the Córdoba district prices vary considerably, depending largely upon the conditions under which the fruit is produced and handled. The common sweet seedling orange, which is grown mostly between coffee trees, usually sells at 1 peso for 144 oranges. During the peak of the harvest in November prices frequently drop to as low as 2.50 pesos per thousand. With few exceptions, however, fruit in this district is badly handled. It is pulled from the trees, dumped into sacks, and loaded onto burros. As a result of this rough treatment, about half the oranges are lost by the time they get to market, and buyers take that fact into consideration.

In orchards where growers give their trees and fruit better care, buyers pay from 20 to 45 pesos per thousand. At the end of January 1942 prices in Córdoba were averaging 30 pesos. For best navels buyers were paying 5 centavos apiece and 40 to 50 pesos per thousand, loose. In orchards that received less care, prices ranged from 28 to 35 pesos. Buyers are willing to pay a premium for fruit from this area because of its superior flavor.

In the State of Jalisco, the following schedule of prices prevailed in 1942: October, 12 to 13 pesos per thousand; November, 14 to 15; December, 16 to 17; January, 18 to 19; February, 22 to 23; March-April, 35 to 40.

Transportation

Transportation is one of Mexico's major problems. The rivers are few and mostly unnavigable. The mountain streams, although numerous, are either raging torrents during certain periods of the year or shallow and nearly dried up in others. They do not serve as a means of communication.

For land communication in Mexico both railroads and highways are employed. Because Mexico is mountainous almost throughout, the construction of these lines of communication is both expensive and difficult, and many out-of-the-way communities must still depend upon pack trains, burros, and Indian carriers to transport their produce to market.

The railway network was constructed principally during the long term of office of Porfirio Díaz (1877-1911).

There are at present some 14,250 miles of track, almost all 30 years old. The railways of Mexico have never been a highly paying proposition, and their condition has deteriorated for many years. At the present time service for fruit transportation is inadequate from the standpoint of both rapid and frequent service and of smoothness of the haul.

Road construction and highways, particularly of the surfaced type, are of recent origin. During the administration of President Cárdenas main arteries were built from the Texas border to Mexico City and from Mexico City to Guadalajara and Veracruz. The highway program continues, and more effort is expected to be made in the future to build roads to service the less developed agricultural areas.

Mexico, like many other countries, has not exhausted its horticultural possibilities. Though arable land is limited, it has not been completely utilized. Fruit growing, however, involves problems other than those of production. A crop must be not only produced but also transported and marketed. Most of the important fruit-producing districts in Mexico are served by either railroad or highway, but in some areas lack of adequate transportation facilities constitutes a serious handicap. The Nuevo León orange districts are perhaps the best served. Though most shipments are made by rail, the location of the Pan American Highway through the area has given added impetus to orchard expansion, and shipments by truck are increasing.

The Veracruz area has both rail and road facilities leading to three of the most important markets in the country; namely, Mexico City, Veracruz, and Puebla. Here, too, the railroads are carrying most of the fruit out of the district, but shipments by truck are on the increase.

Lack of adequate transportation is one of the chief drawbacks of the Río Verde district. There are no roads, only trails, and the train service is poor. Shipments from this district are therefore limited. Río Verde is on a branch line, and the one engine on this route has been in service since 1887. The train makes one trip a day to San Bartolo and return, a total distance of about 50 miles. The train is limited to a maximum of 10 cars, as this is all the engine can pull. The track is straight and level all the way. Now and again during the height of the shipping season two trips are undertaken but not very often. Five days are required to transport a car of fruit to Mexico City, a distance of about 400 miles. Only small quantities of fruit are moved by truck because of the bad condition of the road, and none at all when the road is wet. Most of the fruit from this district is shipped to cities of central Mexico, such as San Luis Potosí, Aguascalientes, and Mexico City. Most of the mandarins from this area are packed in boxes and are moved by express. Oranges, however, are all moved by freight and shipped loose in boxcars and cattle cars.

In Jalisco transportation is also something of a problem, but it is not so acute as in districts farther removed from markets. Fruit is shipped by both rail and truck, the latter increasing in importance. A large part of the crop is sold in nearby Guadalajara, but some is shipped as far as Manzanillo in Colima, Uruapan and Apatzingán in Michoacán, and Mexico City.

Formerly all shipments were made by rail, but a road connecting the producing areas with Guadalajara to the northwest of Lake Chapala is diverting much of the tonnage to trucks. This road is for the most part unimproved and very rough, but in comparison with most unimproved roads in Mexico it makes delivery of the fruit to market without too much injury. Shipments to other markets are by rail. Oranges are shipped in bulk, whether by truck or rail.

LIMES

The wild limes found growing in many parts of Mexico formed until recent years the chief source of supply for both domestic and export requirements. Commercial production of limes is the result of cultivation of trees originally found growing in the forests and along streams flowing through deep *barrancas*, or canyons. In San Luis Potosí, for example, in a section south of Valles, thousands of wild lime trees are found scattered throughout the forests. Also, in Michoacán and Colima, wild trees growing along streams in shady sheltered places provided the foundation stock of the commercial orchards in existence today.

The establishment of a commercial lime-growing industry in Michoacán is attributed to the vision and initiative of an Italian named Cussi, the owner of a large hacienda located between Uruapan and Apatzingán and known as Nueva Italia. Rice was his principal crop at first, but because of his ancestry, the possibility of lemon production suggested itself to him. As a result he imported lemons from Sicily and established a large commercial planting sometime early in the present century. The trees responded well to their new environment and bore good crops. Sicilian, Villafranca, Lisbon, and Eureka were the varieties grown. About 1912 exports were made to the United States, but the fruit did not meet with much favor, and returns were unsatisfactory, largely because of its unattractive appearance.

About this time wild lime trees were noticed on the hacienda, on the bank of a stream flowing through a deep, rocky canyon. The high productivity and flourishing condition of these trees were noted, and Cussi decided that the commercial production of limes, rather than of lemons, would be more profitable. With the commercial production of lemons already established in California and likely to expand, the prospect of more satisfactory returns on shipments to the United States than those previously experienced did not appear bright. A shift from lemons to limes was therefore planned, and the lemon trees were subsequently removed. Fifty-five thousand lime trees were planted by Cussi, and at about the same time the owner of a neighboring hacienda set out 35,000 trees. These two properties, together with a large planting of 40,000 trees at Apatzingán, formed the nucleus of the commercial production of limes in Michoacán.

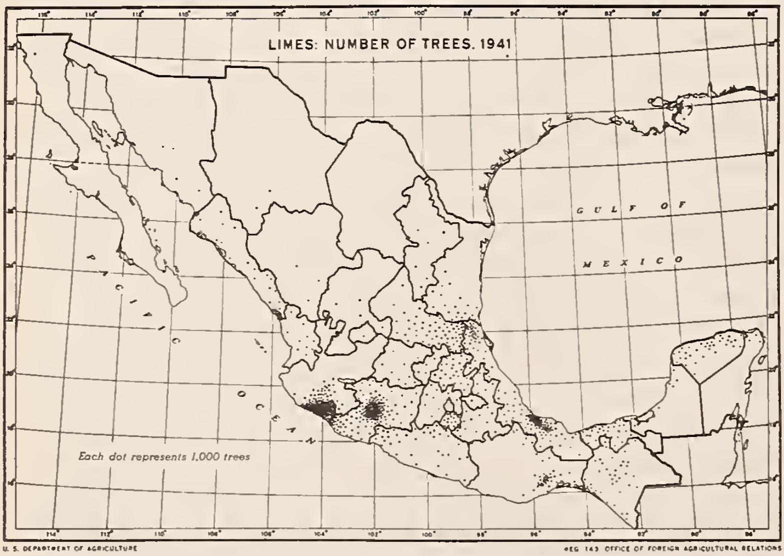

LIMES: NUMBER OF TREES, 1941
GULF OF MEXICO
OCEAN
Each dot represents 1,000 trees
U. S. DEPARTMENT OF AGRICULTURE
NEG. 143 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 46.-Distribution of lime trees in Mexico.

In the State of Colima, commercial development followed a similar pattern. Founded upon lime trees growing wild, the industry expanded until plantings included about half a million trees. In Veracruz and other States where limes are produced commercially, similar stories are told. Trees found growing wild and producing abundant crops of fruit stimulated an interest in the establishment of commercial plantings. In certain instances, however, in Veracruz and San Luis Potosí for example, the bulk of the fruit that enters commercial channels is harvested from wild rather than cultivated trees.

Unlike the orange, which is widely distributed over Mexico, the lime is limited to those States where frosts are unknown, or seldom occur. The lime is strictly a tropical plant and is very susceptible to low temperatures. In Mexico tropical areas are largely in the States bordering the Gulf of Mexico, or the Pacific Ocean - Veracruz, Michoacán, Colima, and Oaxaca. There are also commercial developments of some importance in San Luis Potosí and Jalisco, but they are confined to those areas where conditions are tropical. According to the 1940 census, Mexico has a total of 862,245 bearing trees, which are producing about 36,000 short tons. Limes are grown in all States, but the commercial industry is concentrated in nine States, which in the order of their importance are: Michoacán, Colima, Veracruz, San Luis Potosí, Jalisco, Oaxaca, Guerrero, and Tabasco. Together they produce 80 percent of all the limes grown in the country.

The official statistics list trees of bearing age only and do not include thousands of young trees planted during the past 5 years. As in the orange industry,

TABLE 4.-*Number of bearing trees and production of limes, commercial orchards, Mexico, 1937-41*

STATES	NUMBER OF TREES					PRODUCTION[1]				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*
Coahuila	(2)	(2)	(2)	(2)	(2)	0	0	(2)	(2)	–
Chihuahua	1	1	1	1	2	1	1	2	1	2
Durango	2	2	4	3	3	2	3	6	4	4
Nuevo León	4	4	8	5	5	4	4	13	5	4
San Luis Potosí	64	60	37	55	57	42	45	42	67	69
Tamaulipas	21	19	13	20	20	24	24	14	21	32
Zacatecas	2	2	2	4	4	1	3	2	4	3
Campeche	5	6	5	7	7	7	8	7	9	8
Quintana Roo	5	4	2	3	3	3	4	1	4	4
Tabasco	30	25	26	27	27	37	35	38	38	30
Veracruz	96	101	125	117	130	116	134	131	176	224
Yucatán	22	25	33	34	35	23	31	51	43	46
Baja California	1	1	1	1	1	1	2	2	2	2
Nayarit	10	10	5	11	10	12	13	10	14	14
Sinaloa	14	12	28	17	17	11	13	40	15	15
Sonora	7	5	3	4	4	8	6	4	4	5
Colima	75	107	154	125	127	83	142	235	131	158
Chiapas	30	31	44	39	39	32	42	67	46	46
Guerrero	26	27	35	36	37	33	35	50	45	56
Oaxaca	28	31	33	41	41	28	38	42	60	60
Aguascalientes	1	1	1	1	1	1	1	1	1	1
Distrito Federal . . .	(2)	(2)	1	1	(2)	(2)	(2)	1	(2)	(2)
Guanajuato	6	7	7	9	9	7	10	13	14	15
Hidalgo	16	16	17	25	24	14	18	17	27	30
Jalisco	39	43	43	51	52	45	63	66	109	104
Mexico	5	5	10	6	9	5	8	17	12	14
Michoacán	136	154	126	184	185	171	173	207	305	346
Morelos	10	11	13	14	15	9	11	29	17	19
Puebla	12	12	22	16	17	12	14	24	18	18
Querétaro	4	4	4	4	4	3	4	5	5	4
Tlaxcala	(2)	(2)	(2)	1	1	(2)	(2)	(2)	(2)	1
Total	672	726	803	862	886	735	885	1,137	1,197	1,334

[1] 60-pound boxes.

[2] Less than 500.

production enthusiasm is running high because of the increased demand and the high prices prevailing; new plantings are being established and old holdings increased. Although growers have no assurance that the present prices and demand will continue, they are speculating on the possibility of securing reasonable returns for their efforts.

In the principal lime-producing areas, estimates indicate that only about 50 percent of the trees have reached full bearing age. Since lime trees begin to bear a few fruits at 3 years of age and reach full bearing capacity when about 6 years old, a reasonable expectation is that within the next 4 or 5 years production will be double that of today.

Since the Mexican word for lime is *limon*, which is often translated as lemon, much confusion arises. Furthermore, in official statistics, there is no break-down between *limon* and *lima*. The latter is the sweet lime, a cross between an orange and a lemon, which is produced for domestic consumption only.

Limes in Mexico do not rank high among the other crops produced; from the standpoint of value they occupy thirty-fourth place. Nevertheless, because of their importance in the diet of the people and their export possibilities, limes are destined to increase in value and importance. Production has increased sharply during recent years, and the volume reported in 1940 was more than double that of 1927. Commercial plantings were not undertaken until the latter year, and production prior to that time originated for the most part from trees growing in a wild or semiwild state. Since 1927, bearing trees have increased by nearly 100 percent, and there are about as many nonbearing trees as bearing.

Limes are not widely distributed over the principal producing States but are restricted to well-defined regions or municipalities. Many parts of the producing States are undeveloped, inaccessible, without means of transportation, and have only a limited supply of water. Even areas of commercial production are difficult to reach. Many of the plantings are miles from a railway, and the roads leading to them are unimproved, full of ruts, rocks, steep grades, and unbridged streams.

Michoacán is the most important producing State, with the commercial industry concentrated largely between Uruapan and Apatzingán. Uruapan is frequently referred to as the center of the industry, because it was formerly the railhead, and all supplies from outlying areas were centralized there for repacking and distribution. With the extension of the railway from Uruapan to Apatzingán, completed on January 1, 1942, the latter became not only the center of production but of distribution as well.

Apatzingán is 390 miles from Mexico City and 930 miles from Laredo, Texas, a journey of 18 and 35 hours, respectively. Although the distance between Uruapan and Apatzingán is but 62 miles, the journey by rail requires approximately 5 hours and by road 10 hours. The road traverses very mountainous country with long, heavy grades and sharp curves. The railroad winds and twists, climbs and descends, passes through numerous tunnels, and crosses many deep canyons. The wagon road is no more than a trail, winding its way through desert country strewn with rocks and boulders. The rivers and canyons are not bridged and must be forded or crossed by difficult and circuitous routes. The trail is cut out along the sides of the steep canyon walls and is full of ruts and rocks. Unless one has traveled over these routes, difficulty would be experienced in imagining the terrific punishment that the limes suffer before reaching the consumer in distant United States markets.

Before the completion of the railroad between Apatzingán and Uruapan, limes were trucked to the railhead. Frequently, upon arrival in Uruapan, 50 percent of the fruit was found to be damaged, but the average was about 40 percent. Before reshipment the limes were picked over and all the weak and punctured fruit removed, but this did not eliminate all damage. Shipment by rail from production centers will tend to reduce transportation injuries, but until the roads between the groves and the shipping point are improved the percentage of decay will continue high.

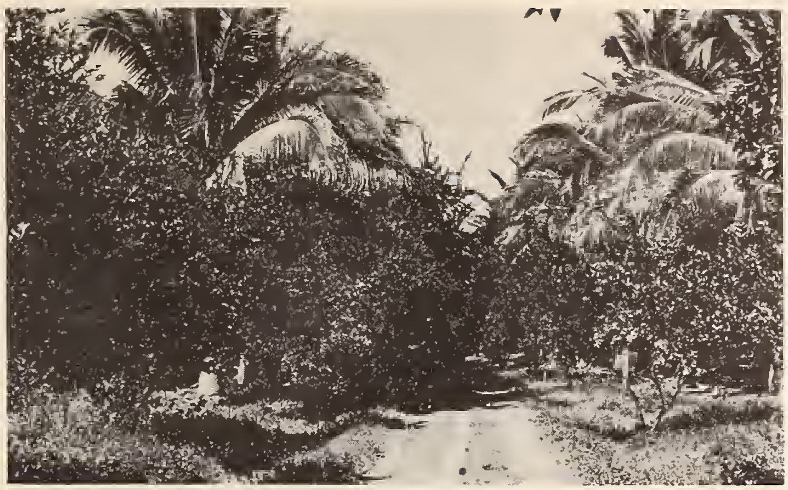


FIGURE 47.-Limes and coconuts at the Hacienda La California, Apatzingán.

In the first attempt to commercialize the lime in the Apatzingán areas, the trees were not planted as a single block but were alternated with coconut palms. Although the coconut is not so well adapted to these areas as to those farther south, along the coast, the intention was not to grow coconut trees for commercial purposes but to use them as shade for the lime trees, although the nuts were sold in local markets for their milk.

Limes from this undertaking were not formerly exported in the fresh state but were sold in the form of oil and citric acid. A processing plant was built 5 or 6 years ago, and during the first 2 years the fruit was used only for making citric acid. The residue was thrown away. At present both oil and citric acid are manufactured. The average price paid for limes ranged from 50 to 80 pesos per ton, although part of the rise was due to increased demand.

Now that Apatzingán has railway facilities, possibly a part of the crop will move out in the fresh form. The amount, however, will be contingent upon the

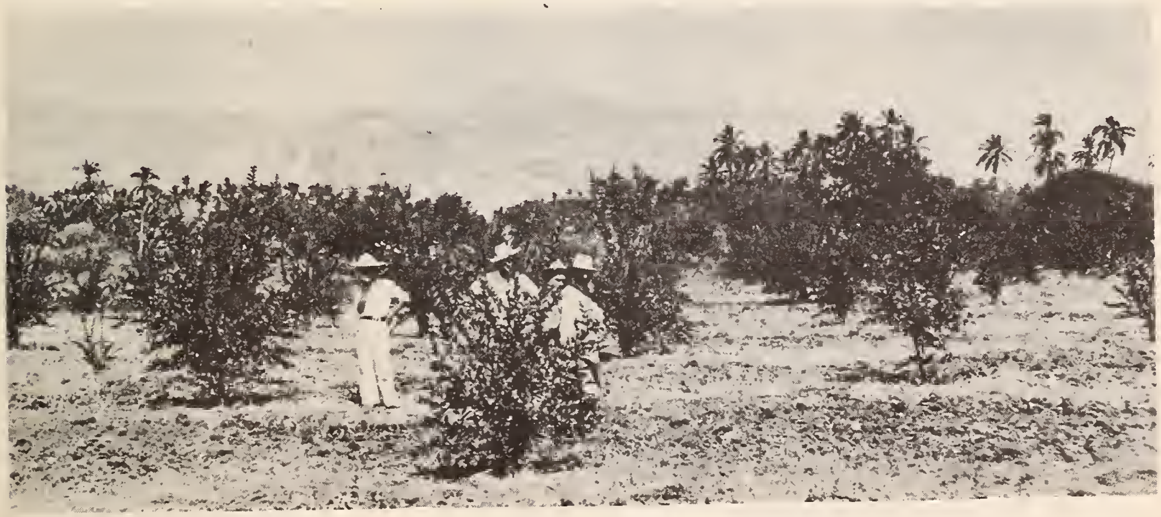


FIGURE 48.-Young lime orchard at Apatzingán.

differential in price between fresh and processed fruit. If prices for the byproduct are more attractive, most of the fruit will continue to be processed.

Soil and climatic conditions in this area seem particularly well suited to the cultivation of limes, as is indicated by the growth and productivity of the tree under wild conditions. The soils around Apatzingán are heavy and black, and trees grown on such heavy adobe-like soils produce fruit of better keeping and shipping quality. It also seems to be somewhat smaller, rounder, and more uniform in size.

The elevation at Apatzingán is around 315 meters (1,033 feet). Rainfall averages around 600 millimeters (23.62 inches) per year and occurs during the months of June through October. This is not sufficient to mature the kinds of crops grown, so moisture requirements are supplemented with water diverted from nearby springs and small streams. The area under irrigation around Apatzingán is about 2,000 hectares (5,000 acres), but sufficient water is available to take care of a total of 5,000 hectares (12,400 acres). Irrigation engineers are active in this district and are constructing additional dams and ditches in order to create a larger supply of water.

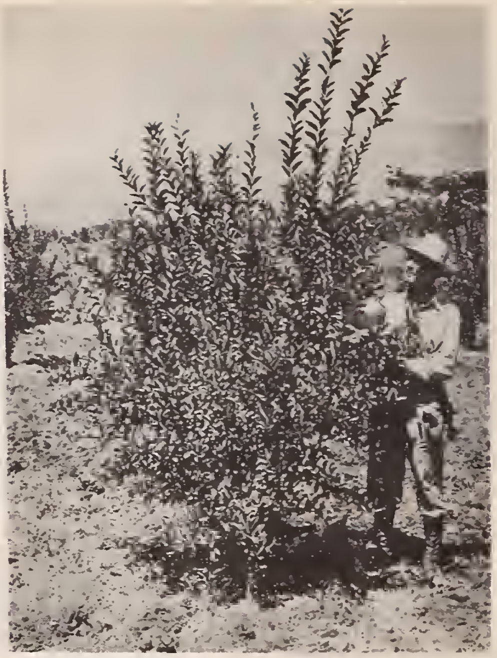


FIGURE 49.-Young well-developed lime tree at Apatzingán, growing under irrigated conditions and in moderately heavy clay soil.

Two experimental stations have been established on the outskirts of Apatzingán in opposite directions from the town. One is devoted largely to investigations pertaining to citrus fruits, with emphasis on limes and a few other tropical tree fruits. The other station is interested primarily in the cultivation of vegetables. The type of work undertaken is more for demonstration than for research, a wise procedure under existing conditions. Agricultural methods in this area are still quite primitive, and it is better to teach the farmers practices that have already been proved safe and practicable. Research in its technical sense would be too advanced for comprehension. The plots at the citrus station are given over to propagation, proper spacing, cultivation, pruning, spraying, and the like.

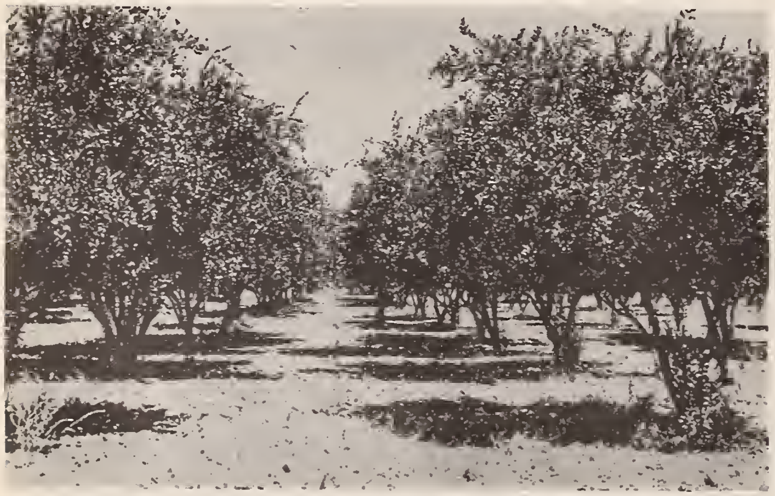


FIGURE 50.-Lime grove in Michoacan of well-grown trees producing fruit of good quality.

Though the Apatzingán area has been settled and farmed for several hundred years, it has been an isolated district and progress has been slow. Natural conditions, however, are favorable and it should have a good future.

From Apatzingán to the Hacienda Nueva Italia is a comparatively short distance (25 to 30 miles), but the journey is an arduous one and requires a long time. The modern passenger car would experience difficulty in negotiating the trails which wind over the desolate stretch of country that separates these two districts. A few scattered Indian huts and an occasional small village are passed en route, but for the most part the trail winds through desert country, in which cacti, scrub trees, and other characteristic types of vegetation are found, and which is said to be inhabited by large numbers of game, such as the tiger (jaguar), lion, puma, wild hog, and small deer. Lizards of various kinds, iguanas, and snakes, including the boa constrictor and large rattlesnakes, are also numerous. Bird life is plentiful, especially the white-wing dove, which was observed in great numbers.

The road is strewn with rocks and boulders, and in parts the land is completely covered with rocks ranging in size from a baseball to a basketball. Since they are too numerous to be avoided, a truck must bump along as best it can. The journey, without wasting any time along the road, requires between 5 and 6 hours.

Upon approaching the Hacienda Nueva Italia, the road passes through large tracts of land given over to the cultivation of rice. From a distance, these fields appear to be planted on smooth fertile ground, but the land is thickly covered with rock. The soil is black, heavy, and almost impossible to cultivate. The rice is sown by hand, and after seeding is completed large herds of cattle are turned into the field to trample the seed into the ground. After this type of "harrowing" has been completed, a large head of water is diverted into the field and allowed to flow until the whole area is inundated.

Although rice is the principal crop produced on this place, the hacienda, having been originally owned and developed by Italians, would hardly be complete without some of the citrus so closely associated with the mother country. Formerly the output of limes from this estate was trucked over miles of rough mountainous roads to Uruapan, where it was graded, repacked, and shipped to Mexico City and to the United States. Now that the railroad runs within a few miles of the grove, shipments will be made by rail.

From the Hacienda Nueva Italia to the Hacienda Lombardia is another comparatively short distance as the crow flies, but by road it is a rough, bumpy ride of over an hour. Lombardia, like Nueva Italia, is primarily a rice-growing plantation, but it has its lime grove of 35,000 bearing trees some miles away, in one of the small valleys. Although the distance to the grove is not great, it requires about 3 hours of travel over an extremely rough mountainous road. The location of the grove itself leaves little to be desired, but the problem of transportation to Uruapan is one which would discourage many people less courageous than these planters. While the railroad is slow because of the topography, it is a great improvement over the old method of road transport. The link between grove and shipping point is still bad enough, but the fruit will not be subjected to the punishment which it formerly had to endure.

An old aqueduct that has long since fallen into disuse runs through the property. This aqueduct is said to have been built and used by the Spaniards to carry water with which to supply a small factory engaged in the manufacture of indigo.

The valley in which the limes are planted has been under cultivation for many years. The soil is heavy and black and, while somewhat difficult to handle, is well suited to limes. The fruit from this district is said to be superior to that of other areas, but production is less.

Colima is the second most important producing State in Mexico and the city of Colima is reached by rail from Guadalajara, a distance of 160 miles and a journey of 7 hours. The elevation at Guadalajara is 5,200 feet. This means dropping from a climate similar to that of Los Angeles to the *tierra caliente*, or hot country. After leaving the high plateau upon which Guadalajara is built, the road begins a steep and steady descent. It passes through a number of small fertile valleys, which are separated by small mountain ranges, and then enters an extremely rough and broken country. The railroad winds along steep canyons, passes through numerous tunnels, and crosses bridges spanning the deep *barrancas*. A few miles to the northwest of Colima is the Volcano Colima, which is still active and which rises to a height of 12,685 feet. Just beyond is Mt. Nevado de Colima which appears to be a twin to Mt. Colima. It towers above the countryside to an elevation of 14,322 feet. Both peaks are forested; on Mt. Colima, vegetation continues up to the lava stream, but Nevado, being inactive, is forested almost to the top. Nevado is snow-capped during certain short periods of the year, but it apparently has little effect upon the climate of the surrounding country.

The Colima producing area includes municipalities in the State of Jalisco, where soil and climatic conditions are more or less the same as those in Colima. Although part of the limes are produced in Jalisco, they are shipped out of, or processed in, Colima. Some limes are produced around Manzanillo, which is on the coast, but the bulk of production centers around the town of Colima. Plantings in this area vary considerably in size. The holdings in the town itself and around the immediate

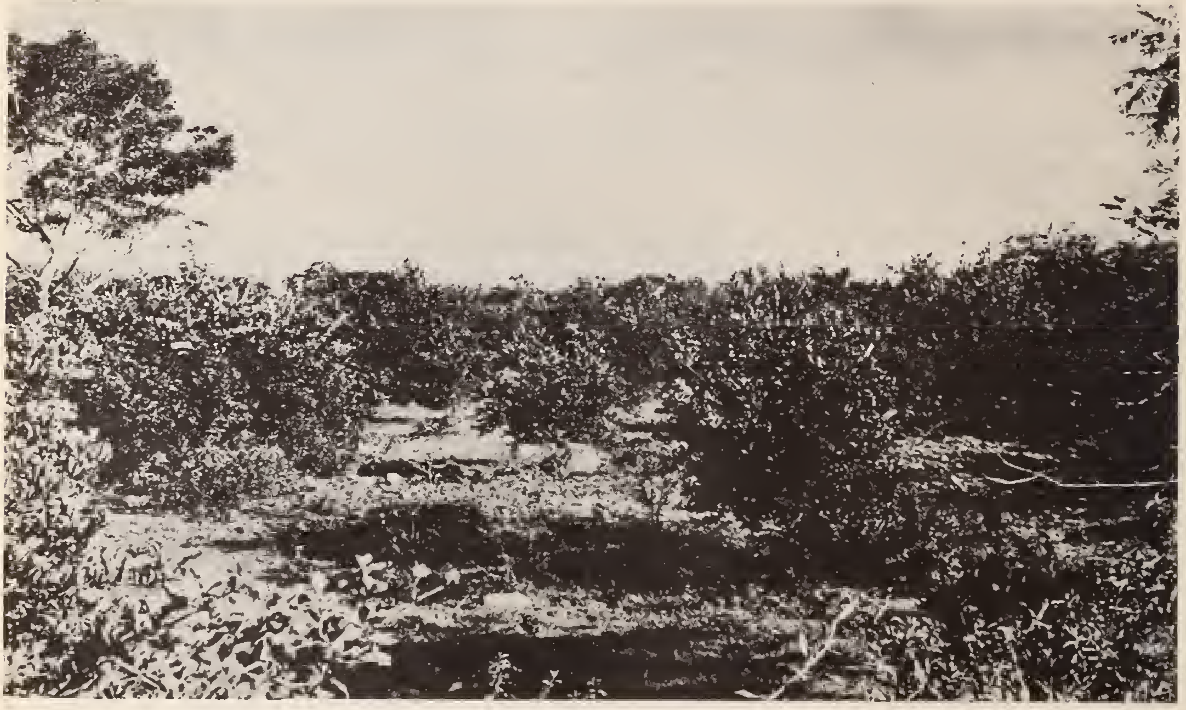


FIGURE 51.-Limes growing near Colima that are somewhat typical of the locality.

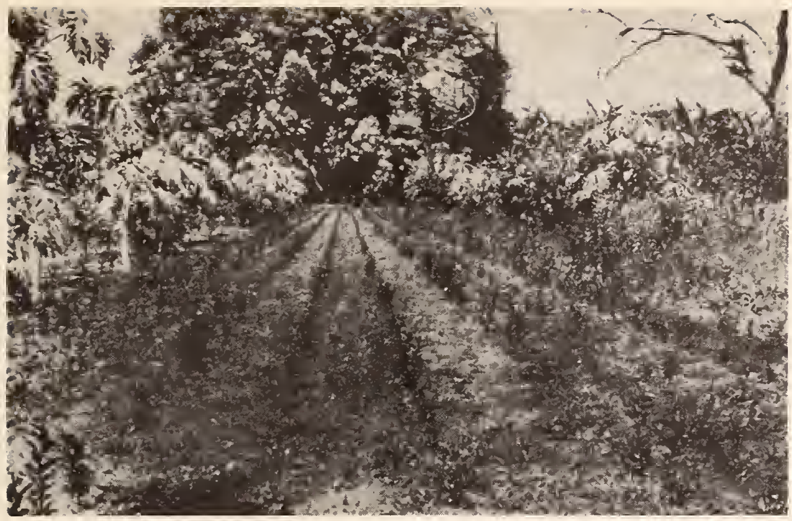


FIGURE 52.-Propagating young lime trees near Valles.

outskirts are small, but farther out in the country they become larger. The total planting of the area, including some trees in the adjoining State of Jalisco, is estimated at around 500,000 trees. Production is said to vary from year to year, according to whether it is an "on" or "off" year. The crop in 1941 was less than in 1940, but the 1942 crop was a large one; first, because it was the "on" year and, second, because a large number of young trees came into bearing. Since estimates indicate that around 55 percent of the trees in the section are of nonbearing age, production is expected to rise sharply during the next few years.

Interest in limes is running high in the Colima area because of increased demand and rising prices. The rate of the increase of new plantings is impossible to estimate, but it is said to be considerable. The processing plants at Colima handle about 60,000 tons of fruit, or about 50 percent of the total crop. About 12,000 tons represent that part of the crop which is produced commercially; the balance is harvested from trees growing wild. At the present rate of planting, estimates indicate that production will increase from two to five times within the next few years. There is a heavy demand for seed, and the processing plants are scarcely able to meet the requirements. Thousands of additional acres, reports state, are being set out.

The third most important State in lime production is Veracruz. Here limes are scattered more or less along the length of the coast, with no particular concentration of plantings. Around Tampico, which is in Tamaulipas but close to the Veracruz state line, some commercial plantings have been set out. Also about 50 miles west of Tampico there is a commercial grove of 10,000 trees. This stock is self-rooted, having been propagated vegetatively rather than by seed, the method most commonly employed. The trees are 5 years old, vigorous, and apparently doing very well. Fruit from this district is sold at Tampico.

The San Andrés Tuxtla area includes the central part of Veracruz and the extreme northern part of Oaxaca. Most of the limes from this area are consumed locally, and very few enter the export trade.

Next in importance to Veracruz is San Luis Potosí, which, according to the last census figures (1940), ranks fourth in number of bearing trees and fifth in terms of production. Valles, which is located in the southeastern part of the State, is said to be the original home of the Mexican lime. This claim, made by residents of this area, is subject to question. About 12 miles south of Valles, however, along the Pan American Highway, wild limes are found scattered throughout the woods in abundant quantities. There are no exact figures to show the actual number of trees growing under these conditions, but the estimates run from 300,000 to 500,000 trees. About

20,000 boxes of limes gathered from these wild trees are shipped to Mexico City annually; the remainder is disposed of locally.

While wild limes constitute the chief source of supply from this area, there is much enthusiasm over the possibilities of commercial production as a result of increased demand and high prices. Some of the enthusiasm is probably unwarranted, and certain undertakings will result in failure, but trees are being planted as rapidly as nursery stock and suitable land are made available. During 1941, 30,000 trees were planted permanently, and over 200,000 lined out in nursery rows. Estimates indicated that during 1942 not less than 50,000 trees would be set out in orchards and many thousands of seedlings would be planted in the nurseries. One grower was especially enthusiastic and, in order to stimulate production in this area, was propagating large numbers of trees, which he was either selling at a low cost or giving away free.

High prices paid by processing plants for limes have stimulated considerable interest in all producing areas and have resulted in a sharp increase in planting. If current prices continue for the next 2 or 3 years, plantings may run into quite high figures. This heavy increase may result in a burdensome supply of fruit despite the abandonment of groves. The expectation is, therefore, that there will be a plentiful supply of fresh limes available for shipment following the termination of the war. Unless measures are adopted to provide for improved growing and handling practices and to create a wider usage for limes in the United States, prices and production practices may be expected to show a comparable decline.

Climatic Conditions

Of the various climatic conditions involved in the successful cultivation of limes, temperature is the determining factor. Even in frost-free districts, limes suffer considerable damage when the temperature drops close to the freezing point. This was proved in the area around Valles during the winter of 1941-42. Near-freezing temperatures killed back new growth and withered the tips of old leaves. Thus, although limes are widely distributed over Mexico, they are best adapted to the "hot countries," where the winters are warm and tropical conditions obtain. In these areas, the trees grow larger and more rapidly, bear earlier, and produce more heavily, Their life span, however, is shorter than that of trees produced in somewhat cooler climates. At the Hacienda California, in Michoacán, temperature ranges from a maximum of 109.4° F. to a minimum of 71.6° F., whereas at Pátzcuaro, where the limes are not so good but still acceptable on the markets, the temperature during 1925-35 ranged from 95.9° F. to 27.5° F.

The question of humidity has not been very well defined in the studies made; present recommendations suggest that limes do best where neither extreme exists.

Elevation has a strong influence upon crop production in Mexico and is perhaps the greatest single factor in determining the adaptability of plant life to one district or another. Since Mexico is very mountainous, the effect of altitude upon the flora there would be extremely interesting to study. Limes are produced from sea level to elevations of 2,200 meters (7,216 feet). At higher altitudes, however, the trees do not yield so heavily and are influenced by the cooler climate. Occasionally they are injured by cold. For highest yields, Colín[3] recommends altitudes ranging from 100 to 500 meters (328 to 1,640 feet), in which range most of the producing areas of Michoacán and Colima are found. The wild lime trees found throughout the country usually grow within this range, indicating that it is naturally the most favorable.

---

[3] Salvador Sánchez Colín, Specialist in Citrus Fruits, Mexican Ministry of Agriculture.

TABLE 5.-*Data on temperatures and rainfall in Mexico, with values of indexes of effectiveness of moisture and of efficiency of temperature and characteristics of climate*

PLACE AND ITEM	MONTHS												ANNUAL
	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
Apatzingán, Mich. -													
Mean temperature (F.). .	77.5	79.9	83.5	86.4	88.9	87.6	83.5	82.4	82.8	83.1	81.0	77.7	82.9
Maximum temperature(av.)	88.3	93.0	97.5	99.7	102.6	99.7	94.5	91.9	90.9	90.3	90.0	87.1	
Minimum temperature(av.)	65.7	67.3	71.2	74.1	76.1	75.2	73.0	72.5	73.8	73.8	72.1	68.4	
Total precipitation(in.)	0.16	0.28	0.04	0.04	0.55	3.51	7.37	6.82	6.62	1.81	0.32	0.63	28.15
Number of days with rain	0	0	0	0	1	7	11	8	11	4	1	1	44
Chauhtemac, Col. -													
Mean temperature (F.). .	70.9	71.6	73.6	77.0	77.9	76.5	74.5	74.3	73.4	73.2	73.2	70.2	73.9
Maximum temperature(av.)	81.9	84.0	87.1	90.1	89.8	85.6	82.4	82.4	80.4	81.1	82.4	80.2	
Minimum temperature(av.)	59.7	59.0	60.3	63.9	65.7	67.3	66.6	66.2	66.4	64.9	63.9	60.8	
Total precipitation(in.)	0.04	0.08	(1)	(1)	0.12	9.38	12.53	12.49	10.64	5.16	0.47	3.11	54.02
Number of days with rain	1	1	0	0	1	15	21	22	20	10	3	4	98
Acapulco, Gro. -													
Mean temperature (F.). .	78.3	78.3	79.3	80.2	82.8	82.8	83.1	82.9	81.7	81.7	80.6	79.0	80.9
Maximum temperature(av.)	86.2	86.2	86.9	87.8	90.1	89.1	90.0	90.1	88.3	88.2	87.6	88.2	
Minimum temperature(av.)	69.3	68.2	69.4	71.6	75.0	75.4	75.0	74.8	74.3	73.8	71.8	70.0	
Total precipitation(in.)	0.35	0.04	(1)	(1)	1.14	16.94	8.51	9.69	14.18	6.70	1.22	0.43	59.20
Number of days with rain	1	0	0	0	3	13	10	10	15	10	2	1	65
Llera, Tamps. -													
Mean temperature (F.). .	60.3	64.6	70.3	76.1	79.5	80.6	81.3	82.2	78.6	73.9	67.3	59.9	72.9
Maximum temperature(av.)	73.6	77.7	84.9	90.5	92.7	93.0	92.5	95.2	90.0	83.8	77.0	73.4	
Minimum temperature(av.)	50.7	53.4	59.9	64.9	68.4	70.2	70.2	70.9	69.4	63.9	59.4	50.2	
Total precipitation(in.)	1.42	0.95	0.79	1.54	4.96	4.77	4.10	2.68	7.80	4.26	1.69	0.59	35.55
Number of days with rain	2	3	4	4	8	8	6	5	11	9	6	4	70

PLACE	LATITUDE N.	LONGI-TUDE	ALTITUDE (Feet)	MOISTURE GROUP[2]	TEMPERATURE GROUP[3]	CLIMATES
Apatzingán, Mich.	19-05	102-16	2,238	30	152	Climate dry and hot with dry season in fall, winter, and spring; without well-defined winter season.
Chauhtemac, Col.	19-20	103-37	1,968	80	126	Climate hot and moist, with dry winter and spring; without well-defined winter season.
Acapulco, Gro. .	16-49	99-55	10	72	147	Climate hot and damp, with dry winter and spring; without well-defined winter season.
Llera, Tamps. . .	23-19	99-01	955	45	123	Climate semidry and semihot, without actual dry season, without well-defined winter season.

[1] Inappreciable.

[2]

Value of moisture group		Character of climate	Characteristic vegetation
128 or higher	=	very humid	rain forest
64 to 127	=	humid	forest
32 to 63	=	subhumid	grazing
16 to 31	=	semiarid	steppes
less than 16	=	arid	desert

[3]

Value of temperature group		Character of climate
128 or higher	=	tropical
64 to 127	=	mesothermal
32 to 63	=	microthermal
16 to 31	=	taiga
1 to 15	=	tundra
0	=	perpetual ice

Soils

The lime has a more exacting soil preference than the orange. Some limes are produced in Mexico on the lighter sandy-clay loams, but the heavier clay, or adobe, soils are much better suited to them. Fruit produced on the heavy soil is reputed to be larger, with a better color, and a heavier juice content, and it commands a higher price in the market. It is also said to possess better keeping and shipping quality. In addition, the trees survive the dry season in better condition. The lime tree bears throughout the year; therefore, it is in constant need of moisture. Sandy soils are not so retentive of moisture, and irrigation is essential if trees planted on them are to give satisfactory results. On the other hand, heavy soils must be deep and fairly well drained.

In Michoacan and Colima, the soil is generally heavy, black in color, and of the adobe type. Much of it is similar to the heavy black soils that are characteristic of the United States Corn Belt or the celery section in Florida.

In the Valles region two types of soil predominate; the river-bottom soil is loose and rather sandy, and the hillside soil is of a heavier clay type. Limes are being cultivated in both, and the heavier lands quite evidently are much better adapted to the trees. In other regions, limes are also grown on a heavy dark-red and chocolate clay-loam soil, which is apparently well suited to them.

Varieties

The Mexican lime crop is gathered entirely from seedling trees, either wild or cultivated. Such varieties as the Tahiti, Persian, Everglade, and Palmetto are unknown in Mexico. The fruit varies considerably in quality and appearance, however, as a result of the different climatic conditions under which it is produced. All the limes grow on trees with thorns, but recently a thornless tree was discovered in the southern part of Jalisco. This tree is under observation and will probably be used for propagating purposes.

The lime tree, even when grown under most favorable conditions, does not attain great size. It can best be described as a small tree, averaging from 3 to 6 meters (10 to 20 feet) in height. It is rather irregular in growth and inclined to be somewhat straggly. Young trees are more symmetrical and compact, but as they begin to bear fruit they become more rangy. Most trees have many thorns, which are rather short, sharp, and stiff. The tendency of the lime tree is to develop several main framework branches near the base,

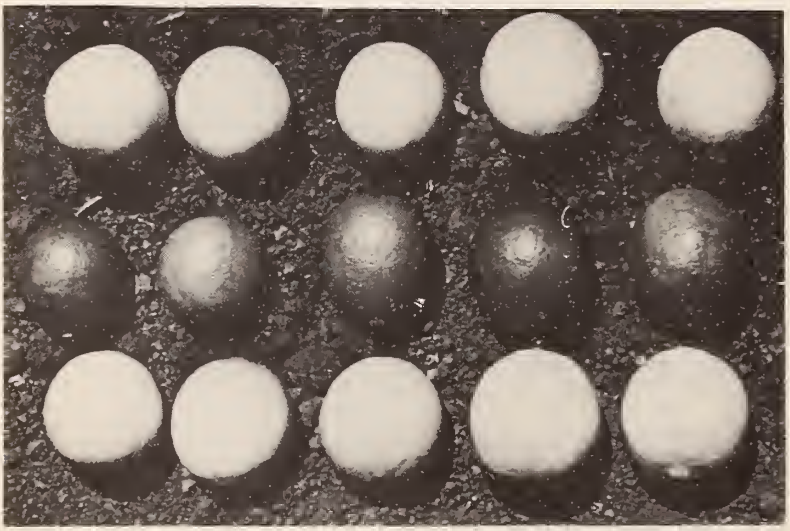


FIGURE 53.-Limes showing the green fruit, as shipped, and the ripe, which is much better and contains far more juice.

which habit of growth is encouraged, since it is said to produce a longer lived tree.

The Mexican lime is small, usually from 1.25 to 2.5 inches in diameter; it is round to oval or oval-round in shape; and it has a smooth dark-green skin, which turns to greenish yellow as it matures. Fully ripened fruit is quite yellow, and the peel is thin and dotted. Seeds are small and few in number, usually three to five. The pulp is greenish, very acid, and has a heavy juice content when mature. Many fruits are harvested when quite green and immature, and the pulp is inclined to be hard and dry. The green fruits are preferred for shipping because they carry better, but from the consumer's point of view a lime that is turning to greenish yellow is far superior in juice content, quality, and flavor.

Young trees, just beginning to bear, produce fruits that are somewhat rough; as the trees grow older, however, the skin of the fruit becomes smooth.

Cultural Practices

Propagation. The lime tree in Mexico is grown almost entirely from seed. Only one orchard visited, near Tampico, had trees that were propagated vegetatively. Budding, when practiced at all, is on an experimental rather than commercial basis. Seeds are secured, in many instances, from the processing plants and are mixed in with the pulp. The pulp is planted just as it comes from the pressing machine, and when the seeds germinate they push their way through the soil, usually in masses. Sometimes, however, the seeds are washed or separated from the pulp and planted in seedbeds. They do best when they are fresh and moist. Planted in this condition, between 50 and 75 percent usually germinate; if allowed to become dry, the germination is much lower. The best seeding time is during the rainy season, which, in the lime-producing regions, occurs from June to October, with the heaviest rainfall in August and September. Seeding in April and May is not recommended, because low humidity and heat cause considerable injury to the young plants. Seeding in the winter months is not satisfactory because of slow germination and possible injury from sudden drops in temperature. A few warm days cause limes to grow rapidly; a subsequent sharp drop in temperature is apt to injure tender shoots.

The seedbeds are usually covered with straw or mulched with trash of some kind. This helps to retain moisture and provides additional warmth. Just before the young plants begin to break through the topsoil, the trash or mulch is removed. The seedbed must be watered and kept moist until the plants are ready to set out in the nursery row. They are grown in the nursery from 8 to 12 months, until they have attained a height of from 65 to 85 centimeters (about 2 to 3 feet). Planting in the "hot country" is usually done from June to the end of September. It may be done at other times, but a good supply of water must be assured for transplanting.

Planting Systems and Distances. Planting systems are more or less uniform throughout the country, but spacing distances vary considerably according to soil, climate, and the custom of the region. The square system is the most widely used, although occasional orchards follow the hexagonal system. Many of the older orchards have been planted too close. Young orchards are being given more room but could still stand a bit wider spacing.

The trees in some old orchards were set out from 4 to 5 meters (13 to 16 feet) apart on heavy strong soil. Consequently, after a few years, the trees had grown together, forming a dense canopy over the occupied area. Even at high noon it was like dusk beneath the trees. Most of the old orchards in Michoacán were planted with the trees spaced 16 by 16 and 19 by 19 feet apart. Present plantings are being spaced 23 by 23 and 27 by 27. The former is more common, but under certain conditions a greater spacing, that is, 27 by 27, would appear to be much more desirable.

Pruning at Time of Planting. Lime trees do not require much pruning, except to remove dead and diseased wood. When growing wild, they flourish without any attention. In cultivated groves, however, the training of the young tree is considered by some of the more advanced growers to be one of the essential practices, since the longevity of the tree is said to be more or less influenced by proper handling during the formative period.

Most trees are headed rather low, from 12 to 18 inches from the ground. Instead of spacing three or four lateral branches around the trunk or central stem, it is considered advisable to grow from two to four strong limbs about equal in size, which are developed as main framework branches. This system suggests the formation of a weak tree structurally, but lime wood is strong and willowy and does not split at the crotches like apple or peach trees.

Furthermore, growers claim that trees developed with a central shaft live to be only 12 to 15 years old, whereas when three or four main framework branches are developed the average expectancy is around 25 years.

Pruning During Later Years. If any pruning is done to older trees, it usually consists of removing water sprouts and the lower limbs. Frequently, the trees are overpruned at the bottom and underpruned in the tops. Not much care is given to pruning cuts. Stubs extending 2 to 3 inches from the parent limb are often seen. The removal of water sprouts is carried out rather perfunctorily; the sprouts are usually pulled rather than cut away from the trunk or framework limbs.

Opening up lime trees in order to permit the entrance of light is not desirable. The fruit does best when shaded; when it is not shaded it takes on a yellowish cast that is undesirable from a marketing standpoint. The tree should be as compact as possible, and the limbs should not be allowed to grow too long and leggy. If they are not headed back, they will whip around in the wind and cause a lot of scarred and spine-punctured fruit. In actual practice, most of the pruning is done during the first 2 or 3 years after planting.

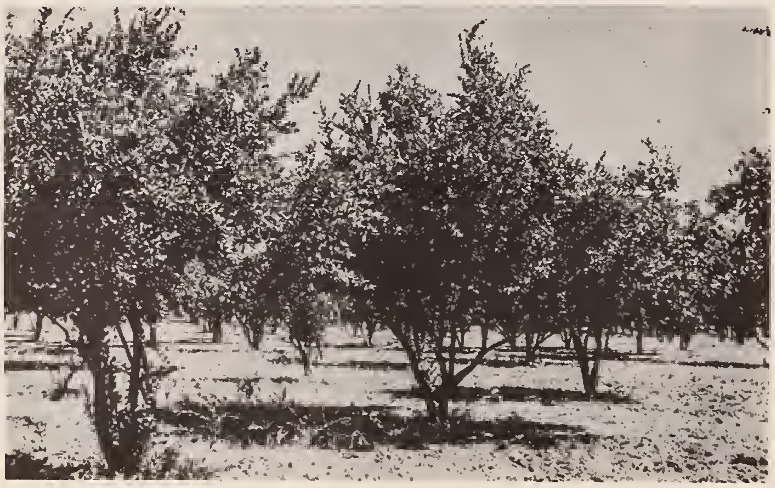


FIGURE 54.-Lime grove at Michoacán showing type of pruning.

Interplanting. Since lime trees are lovers of shade, the custom in the more tropical areas is to interplant with coconut palms. In the hotter regions, that is, along the coast, the coconuts have a commercial value and are harvested and sold as a cash crop. At the higher altitudes, however, they have little value, except for the milk, and are planted primarily to provide shade for the limes. Where this system is in vogue, the limes are

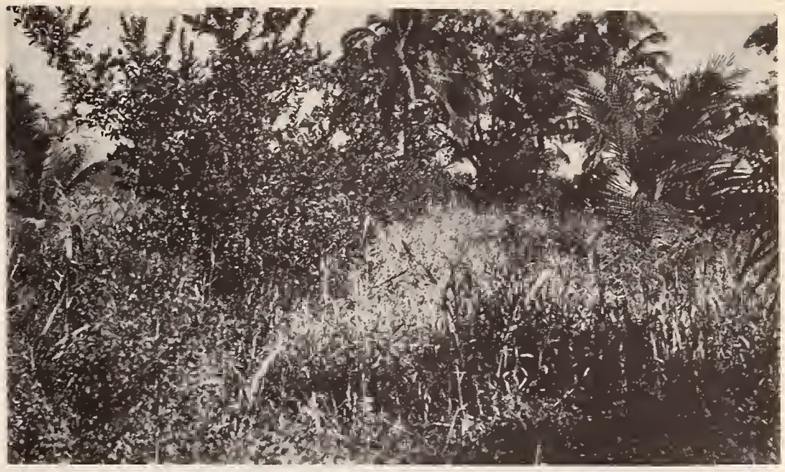


FIGURE 55.-Young lime trees interplanted with palms; cover crops of weeds and sorghum in foreground.

usually spaced about 8 meters (27 feet) apart. The palm occupies the space of every third tree; that is, two limes are planted, then a palm, and so on through the orchard.

Cultivation and Cover-Cropping. Young lime orchards are usually cultivated during the first 3 or 4 years following planting. Little is done thereafter, except to furrow for irrigation and keep down the weeds. When lime trees begin to bear, at about 3 years of age, the groves receive little attention. The rooting system of lime trees is rather shallow, and a large part of the feeding roots are said to be within a few inches of the topsoil. Cultivation, especially plowing, destroys many of these roots and is therefore discouraged. The weeds are kept down with hoes, and occasionally cover crops are turned under; but as a rule cultivation, especially clean cultivation, is not recommended for lime orchards.

Cover crops of various kinds are used, but they consist mostly of the volunteer ground covers that are indigenous to the area. Lime trees are said to behave badly if pampered too much; they thrive better if allowed to grow more or less wild. Even when the land is plowed occasionally, most growers allow the weeds and grass to grow up between the trees and turn the cattle in to graze. Some groves are so thick and shaded, however, that cover crops find difficulty in growing. In some cases wandering-jew (*Tradescantia fluminensis*) is used, which makes a very good cover. Although tillage is restricted as much as possible, the groves do not appear neglected, since weeds and other foreign plants are kept well in hand and the ground fairly clean. The weeds and grass are frequently cut at the surface of the ground and left as a mulch.

Intercrops. Intercrops are sometimes grown between the tree rows in young groves. It is not, however, a general practice and is discontinued after the trees reach bearing age. Beans and corn are the crops most commonly used, but in one grove visited sorghum was used for this purpose, and in another sesame.

Fertilization. Other than the fertility which is derived from cover crops and decayed organic matter, such as rotted grass, weeds, etc., lime trees receive no fertilization. Here again the common belief is that lime trees do better when left to themselves. Wild trees, which produce a large part of the total crop, are not fertilized; therefore, to feed those that are cultivated is not considered necessary. The belief is that fertilization would produce large-sized fruit, which is undesirable, and, in addition, would impair keeping and shipping quality. The limes that are considered best are small to medium in size, hard, green, and firm.

Insect Pests and Diseases and Their Control. The lime is said to be comparatively free from the pests that commonly attack other citrus fruits. The truth is that they are far less susceptible to these troubles, but they are not altogether immune. The fruitfly, which attacks and causes much damage to oranges and grapefruit, does not attack the lime. Among the insects, the red and the black scale are considered to be the most troublesome, whereas black fungus and lime anthracnose, or withertip, are the most serious diseases. Anthracnose produces the hard, brownish, wartlike spots which are so frequently seen on Mexican limes. Most of the affected fruits are culled out at the first selection and constitute the largest percentage of grade defects.

Limes are seldom, if ever, sprayed. A few large operators make one application to control scale, but these are exceptional cases, and the single application is not considered effective. At least one additional spray is required. In Michoacán and Colima scale insects are said to be on the increase, and the few growers who have attempted to control them by spraying have become discouraged. They say satisfactory results are impossible to get when the large majority of growers make no effort at all to spray. No attempt has been made to control anthracnose through spraying with the recommended treatment of Bordeaux mixture.

Irrigation. With the exception of the wild lime trees, which are found growing along the banks of streams and in densely shaded damp forests, the lime is usually irrigated. Commercial plantings, as a rule, are located where they can be assured of a good supply of water during the dry periods. In most instances the irrigation water is diverted from nearby mountain streams and springs, but in some cases the water is carried considerable distances through canals and ditches. Some of the latter projects were established by the Spaniards about 300 or 400 years ago. Sometimes water from streams is supplemented by that from wells, which are from 50 to 60 feet deep.

In some areas the water supply is abundant, but in others a shortage occurs during certain periods, due largely to poor distribution. In the Colima area deforestation is reported to have reduced the supply of water. Streams there are smaller than they were a few years ago. Furthermore, the farms on the upper end of the canals use more water than is necessary, leaving a shortage for those on the lower end.

North of Apatzingán in Michoacán, the Cupatitzio River,[4] which flows across the country near Uruapan, supplies the irrigation water. It is diverted through a system of canals that wind along mountain sides through the arid desert country. The largest canal carries a flow of 7.5 cubic meters (about 264.9 cubic feet) per second, and the small one has a flow of 2.45 cubic meters (about 86.5 cubic feet) per second. The canals pass through the Hacienda Lombardia on their way to Nueva Italia. Resident engineers calculate that about 60 acre-inches of water are applied. This, together with the summer rainfall of about 600 millimeters (24 inches), is more than ample to take care of the requirements. At Apatzingán water is obtained from small rivers and springs. The springs seem to have no source but gush forth in the middle of a desert. Presumably, they are the outlets of some subterranean river. There is a tendency to be wasteful if water appears to be plentiful. It is frequently seen running down roads and across desert wastes. Distribution does not appear to be supervised; and, although water is the life blood of the country, full appreciation or utilization of it is not being made.

The most common method of irrigating limes is the flood system. Banks or dikes are thrown up around a rather large area. A large head of water is then turned in and allowed to flow until the whole area has been covered to a depth of 1 to 2 inches. It is then turned into another area and the process continued until the whole orchard

---

[4] The Río Cupatitzio flows into the Río Márquez after passing by Lombardia and Nueva Italia.

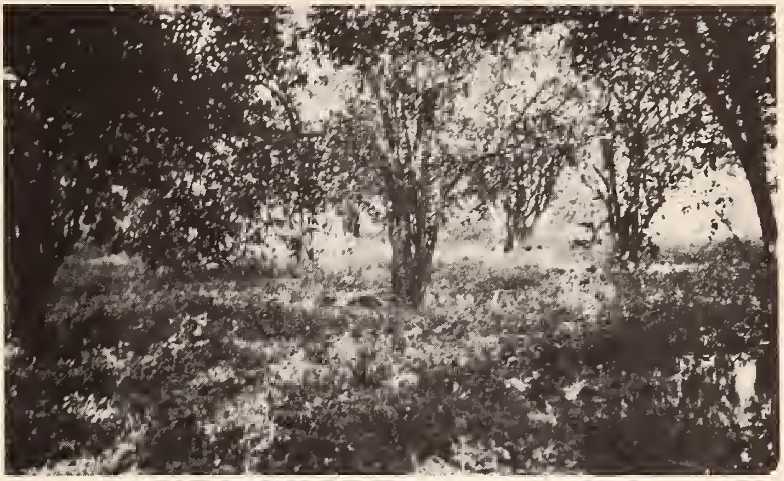


FIGURE 56.-Flood system of irrigation practiced in lime groves.

has been covered. This system, in addition to the density of shade brought about by the close planting of the trees, provides an ideal haven for insect pests, especially mosquitoes.

The basin system is used in a few instances, but ordinarily this requires too much work and also calls for more cultivation than is considered desirable for the trees.

The number of applications varies according to district and is governed by the type of soil, age of trees, season of the year, and climatic conditions. The lime requires plenty of moisture, more than the orange needs; and, since the lime produces almost constantly, an ample water supply is essential at all times. The heavy clay soils, which are more retentive of moisture, do not need to be irrigated so frequently as trees planted on the sandier soils. In young orchards planted on sandy soil water is sometimes applied every 2 weeks. In the heavy clay and adobe soils, every 3 to 4 weeks is considered sufficient. By applying water judiciously and at the proper time, harvesting seasons can be controlled more or less. Although limes blossom and bear fruit the year around, harvesting reaches two peaks. In Colima heaviest pickings occur from May to July and from August to December. The peak of production comes after the rainy season of April, May, and part of June. When sufficient water is made available, the heavy picking season can be advanced to February, which is more desirable from both the standpoint of price and the condition of the fruit. Shipments made during, or immediately following, the rainy season are weak and very susceptible to decay, and losses run as high as 50 percent upon arrival at the border towns.

Some orchards have not been properly laid out for irrigation, and control of the distribution of water is difficult. Part of a grove may receive too much and others too little. The best results are obtained from trees, cultivated or wild, that are provided with a good supply of moisture throughout the year.

Harvesting Season and Methods. The lime is in an almost continuous state of fruition. Blossoms, newly formed fruit, half-grown fruit, and fully matured fruit are found on a lime tree at all times. For family use it is a most convenient tree to have. If one has fish for dinner, or visitors drop in for a cocktail, one needs only to step into the garden and pick limes, properly matured, for the occasion.

As pointed out previously, limes are harvested during every month of the year, but the heaviest movement occurs during the summer months following the seasonal rains. This corresponds with the summer demand for this fruit, especially in the United States. Shipments during June, July, and August represent 50 percent of the 12-month total.

TABLE 6.–*Harvesting periods for limes in Mexico, by producing zones*

REGION	MONTHS OF MAXIMUM HARVEST	MONTHS OF MINIMUM HARVEST
Colima - Jalisco	June to November	February to March
Michoacán	June to November	January to April
San Luis Potosí - Northern Veracruz	July to August	March
Morelos - Southeastern Puebla	July to August	February
Central Veracruz - Central Oaxaca	October to December	February to April
Yucatán	June to July	March to April
Tabasco - Chiapas	June to July	January to February
Guanajuato	August	February
Sinaloa	Harvested throughout the year	

The August and September rains produce a second harvesting season, but it is more evenly distributed and does not reach peak proportions, as is the case following the April and May rains. Most of the limes harvested for export are from cultivated groves, but in some locations there is an important movement of fruit gathered from wild trees. These shipments originate largely in the Valles, Tampico, and Veracruz districts.

The harvesting of limes is not an easy operation because of the sharp spines which cover the tree. A thornless variety would be a distinct advantage, not only because of the difficulty in gathering, but because of the large number of fruits that are punctured. In most areas limes are gathered with a long pole on the end of which is a sharp, curved hook. The hook is placed just above the fruit, given a twist and a pull, which severs the stem. The lime drops to the ground, is picked up, and then placed in a basket.

In the Colima area a long pole is used, but instead of a hook a cup-shaped mechanical arrangement is provided. One-half of the cup swings free on a lever arrangement and is manipulated by a rope that hangs down along the handle of the pole. The lime is placed between the two

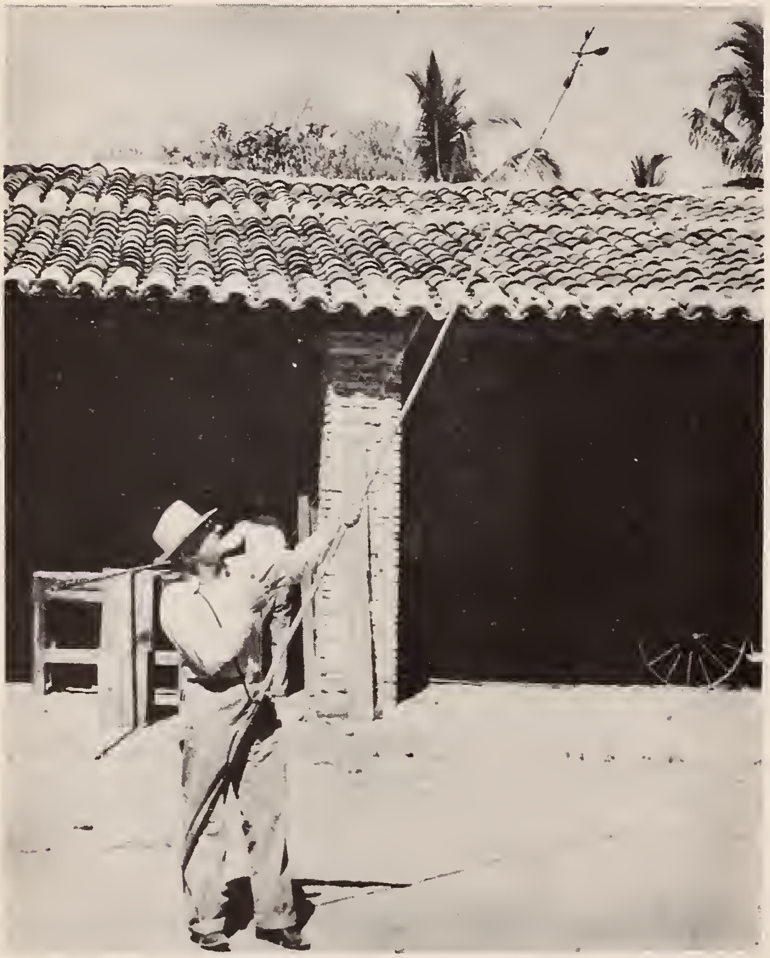


FIGURE 57.-Mechanical lime picker.

halves of the cup, which is then closed. A twist breaks the lime off. This mechanical picker, which is used quite extensively in the district, is, perhaps, slower than the hook; but it certainly reduces injuries from thorn punctures, as well as from the fall to the ground. Ordinarily, the damage resulting from spine punctures is said to amount to around 15 to 20 percent at least.

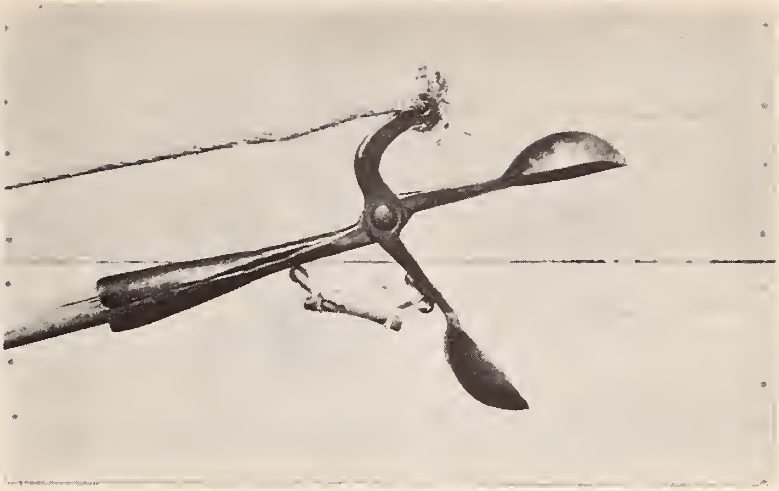


FIGURE 58.-Close-up of picker used for limes.

Yields

Yields per tree vary considerably from one season to another, depending upon the individual performance of the tree. It may give a heavy crop one year and a light one the next. On the average, however, in the warmer climates, a tree produces from 500 to 1,000 fruits or, in some cases, somewhat more.

In Michoacán average production is calculated on the basis of one box of 30 to 33 kilos (66 to 73 pounds) net per tree. A box contains from 700 to 800 medium-sized fruits - 40 millimeters (1.6 inches) on the short axis. The production of wild trees is unknown, but the average is approximated at 500 fruits per tree.

Grading and Packing

Before the fruit is graded or packed, it is allowed to dry thoroughly. It is poured out on a large, slatted, dumping table, which is the receiving unit leading to the sorting belt and sizing rollers, and spread out evenly in order that dew and other moisture may dry off more readily. When it is dried, it passes over the grading belts, where the punctured and blemished limes are removed. It then passes along to the sizing units, where it is separated into three sizes with a range of from 33 to 47 millimeters (1.30 to 1.85 inches) in diameter. The three sizes are described as small, medium, and large.

Fruit shipped and sold on the domestic market is mostly tree-run, ungraded, and unsized. Furthermore, all stages of maturity are included. For the export market, however, care is taken to exclude fruit that is turning yellow, which indicates advanced maturity. Such fruit, though really superior, will not hold up under present methods of handling and transportation. The North American market has been educated to a small hard green lime, but the larger, more mature fruit has a heavier juice content and is much higher in quality.

After the fruit for the export market has been graded and sized, it is jumble-packed in containers known as petroleum boxes. The boxes are lined with paper, which gives the fruit some protection against dirt, dust, and other foreign matter, but pads, or liners, to cushion or protect the fruit from bruising are not provided.

Two kinds of boxes are used. One is known as the Colima box and contains 27 kilos net weight, or nearly 60 pounds of fruit; the other is the Michoacán box, which

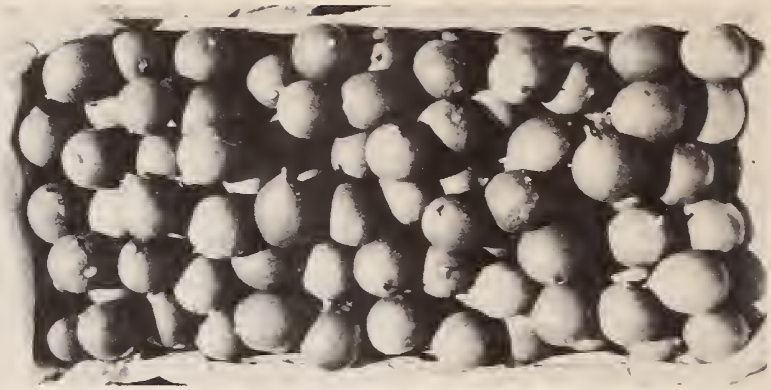


FIGURE 59.-Box of limes packed for shipment to the United States.

contains 33 kilos (about 74 pounds) of fruit. The Colima box is (inside dimensions) 19 inches long, 9.5 wide, and 14.25 inches deep; the Michoacán box, 18.875 inches long, 12.25 wide, and 12.1875 inches deep.

These containers were adopted, because the fruit was formerly packed in the empty kerosene boxes which had contained two 5-gallon cans of gasoline or kerosene. Since these empty boxes, formerly in great demand, are no longer available, shook for boxes of the same size is produced locally, bundled, and shipped out in carlots to the packing districts. They are made up on the farm, where a man can make an average of around 100 boxes per day.

Mechanical grading and sizing equipment is used in only a few places. Most of the selection is done after the fruit reaches the United States port of entry. When mechanical sizers are not available, it is sorted by hand into small, medium, and large sizes.

Central packing houses are unknown. The first selection takes place on each individual farm, where the fruit is also packed. Between 40 and 50 percent is discarded, largely because of blemishes and mechanical injury, and is sold in the Mexican market, partly as fresh fruit and also very extensively for manufacture into byproducts. In the Colima district, the fruit is classified into the following grades: No. 2 grade, the best, which contains small, hard, green fruit; No. 3 grade, which consists of hard green fruit, but of larger size; and No. 4 grade, which includes fruit mixed as to size but firm and more mature.

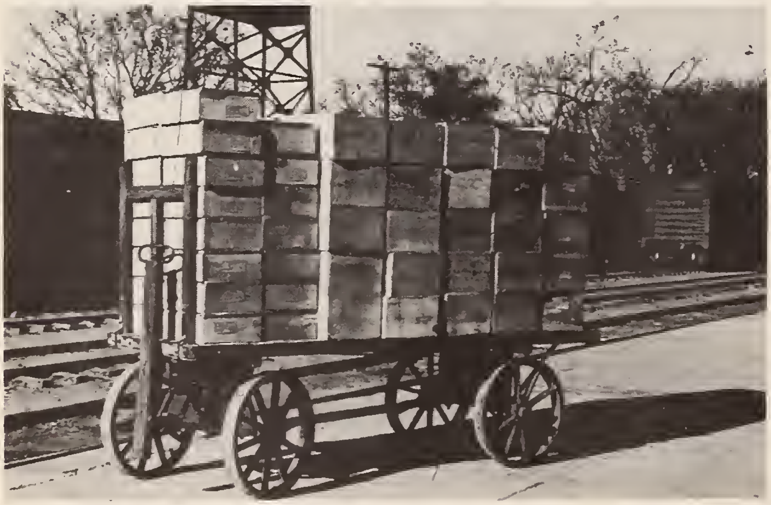


FIGURE 60.-Boxes of limes awaiting express shipment at Colima.

After the boxes are packed, they are lidded and strapped; a single strand of wire fastened around the middle of the box serves as strapping. Shipments from Colima are by express and are consigned directly to the buyer or distributor at one of the United States points of entry. Those originating in Michoacán, however, are first forwarded to Uruapan, where the buyer reselects, repacks, and ships the fruit on to the border. With the completion of the railroad to Apatzingán, this arrangement may perhaps be altered. Buyers are already going into the producing areas for their requirements, and quite possibly the initial grading and packing will be done on the farm and the fruit billed from the original shipping point straight through to the United States point of entry, as is the case in Colima.

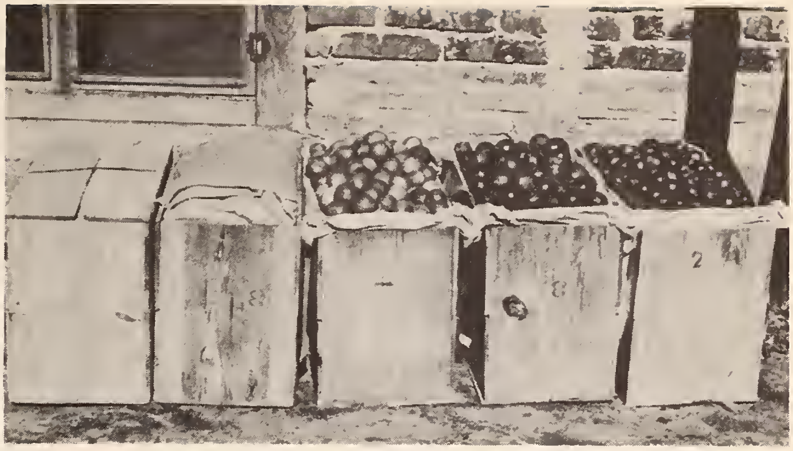


FIGURE 61.-Limes at Colima graded and packed for shipment.

Prices Paid to Growers

Prices vary not only from season to season but from month to month, depending largely upon demand in the United States and upon local conditions, such as competition from processing plants. Values have ranged all the way from 50 to 400 pesos per ton. Prices in 1942-43 ruled high, increasing from five to six times over former levels.

The dislocation of supply under war conditions has created a shortage of fresh limes as well as of lime oil and citric acid. High prices in the United States are reflected in increased returns to the producer.

In Colima processing plants, prior to the war, paid 5 to 6 centavos per kilo (about 0.5 cent per pound) for limes, whereas they are now paying 30 centavos. Limes for export are selling for around 300 to 350 pesos per ton (around $67.00).

In Michoacán one processing plant formerly paid from 50 to 80 pesos per ton. A second plant was established, competition set up, and prices increased up to 250 to 350 pesos per ton. A part of this increase, however, has been due to demand and the shortage of supply. During February 1942 buyers in Uruapan were paying 350 pesos per ton for orchard-run, delivered in boxes at the railway station. Offers of 400 pesos per ton were made for the month of March. Producers who sell to buyers in Uruapan usually contract the sale of their fruit on a month-to-month basis. They pick and deliver the fruit to the car in boxes. The buyer then assumes full responsibility, ships the fruit to Uruapan in boxes, bags, or in bulk. Upon arrival, the fruit is classified, repacked, and reshipped. Off-grade fruit, and that which is too mature for export, is processed.

The best prices are realized during the months of January through May, and lowest values rule from June to December. Peak prices occur during March and April, which is the season of shortest supply. Values are lowest from June through November, the season when supplies are heaviest. This indicates the seasonal character of the typical fluctuations in perishable products.

Prices during the year 1934 to 1936 reached low levels, but they turned upward in 1937 and rose steadily until 1940 when they exceeded those of 1933. The increase in export prices, however, was practically offset by the depreciated value of the Mexican peso.

TABLE 7.-*Wholesale price of limes in Mexico City, 1933-40*

YEAR	ANNUAL AVERAGE PRICE PER POUND		1933-40	AVERAGE MONTHLY PRICE PER POUND
	Pesos	*U. S. cents*		*Pesos*
			January	0.11
			February	0.13
1933	0.13	4	March	0.16
1934	0.08	2	April	0.15
1935	0.06	2	May	0.11
1936	0.08	2	June	0.10
1937	0.10	3	July	0.09
1938	0.11	3	August	0.08
1939	0.12	2	September	0.09
1940	0.15	3	October	0.09
			November	0.09
			December	0.10

Mexican Bureau of Agricultural Economics, Department of Agriculture and Development.

Exports

Mexican limes are exported almost exclusively to the United States. Prior to the war small quantities were shipped to England and Germany, but the volume did not reach commercial importance. In view of the location and the fact that the United States does not produce sufficient limes to supply domestic demand, the North American market continues to be Mexico's best outlet. Exports, which increased steadily from 1929 to 1937, dropped sharply in 1938 and have been declining ever since. Mexican shippers attribute the decline in exports to a falling off in demand, but there are other factors that more clearly reflect the real reasons; they are included in the discussion on page 172.

Exports to the United States are routed almost entirely by rail and enter at various border towns, such as Nogales, Eagle Pass, El Paso, and Laredo. Laredo is the chief point of entry and accounted for 5,311,000 pounds, or 92,728 containers in 1941.

A large part of the exports are shipped in small lots of from 10 to 100 boxes. Occasionally they arrive in carlots containing from 500 to 600 boxes. Shipments from Colima are packed in boxes weighing 58 pounds net; those from Michoacán weigh 65 pounds net. Upon arrival in the border towns of the United States, the limes are removed from the shipping container, washed, regraded, Brogdexed,[5] and repacked into cartons and boxes weighing up to 45 pounds net.

Of the relatively few shipments by sea, an occasional lot is exported from Manzanillo and Veracruz. Despite a fairly large production on the Gulf coast, two shipments invoiced at Veracruz in 1937 and 1938 originated from the States of Colima and Michoacán, which necessitated a long rail haul before reaching the opposite seaboard.

The relationship between the production and the export of Mexican limes is difficult to measure, because only a minor portion of the annual output is exported. On the average it represents around 18 percent.

---

[5] Brogdexing refers to a secret, patented process used in connection with the treatment of citrus fruit to improve its keeping quality. The fruit passes through a waxing bath which gives it luster in addition to prolonging its marketing life.

CITRUS-FRUIT BYPRODUCTS

The manufacture or extraction of byproducts from citrus fruits is a relatively new industry in Mexico, and to date it is confined to the utilization of limes. There will probably be no great impetus to manufacturing products from oranges until heavy fruit production is reached a few years hence as indicated earlier in this study.

Limes are largely utilized for the expression of essential oil. In 1941 about one-half the crop in the commercial zones of Colima and Michoacán was used for industrial purposes and the remainder for fresh shipment. Small amounts of citrate of lime and citric acid are also produced. Nearly all the oranges produced are shipped and consumed fresh within the Republic. Even in the case of orange juice, squeezing is commonly done at small stands along the street for direct sale, and juice is not bottled or otherwise prepared.

Lime Oil

Substantial quantities of essential oil of limes are produced, which are almost entirely for export to the United States. Production began to be of importance in 1934, when the first factory was established in Colima, although prior to that time small quantities were exported. Studies reveal that United States import statistics are the most accurate measurement of the industry. (See table 8.)

TABLE 8.-*United States imports of lime oil from Mexico, 1934-41*

YEAR	POUNDS	YEAR	POUNDS
1934[1]	2,898	1938	36,570
1935	23,875	1939	32,869
1936	20,576	1940	47,474
1937	39,192	1941[2]	45,622

[1] Not shown separately prior to 1934. [2] January-September only.

In 1941 the output jumped. Prices of fruit for the expression of oil rose so rapidly that by the end of the season fruit for processing was almost as high as fresh fruit for export. Not only were limes utilized from commercial production areas contiguous to processing plants, but shipments from rather distant points were also made. At Colima, for example, fruit was received by rail from the coastal areas and by coastwise shipping and rail from Jalisco. Just how much oil was turned out in 1941 is not yet known. A partial survey of the situation indicates that it amounted to about 109,000 pounds, with origin and calculated amounts of fruit used as follows:

	Oil produced	Fruit utilized
	Pounds	*Metric tons*
Colima	50,000	6,250
Michoacán	50,000	6,250
Guerrero (Acapulco)	5,600	700
Veracruz	3,500	440
Total	109,100	13,640

Fruit consumption may have run higher than indicated, since, according to estimates, 1 ton of fruit yields 8 pounds of oil, and many plants probably did not obtain such a high yield.

High prices paid for limes by the processing plants stimulated the gathering of this fruit so much that production of oil in 1942 was probably far in excess of previous expectations. It may have reached somewhere between 150,000 and 200,000 pounds. Byproducts plants, in addition to receiving the usual small, cull, or off-grade limes, are now getting about one-half the usual supply of those of shipping quality; that is, those which are usually shipped within the country or destined for export in the fresh state.

A planting fever has hit growing areas, and reports from Colima state definitely that people are coming to the factory to cart away sacks of pulp containing seeds. At the present rate, plantings appear likely to run into the millions. Lime-oil prices have suffered some decline from the high levels prevailing earlier in 1941, but they are still high enough to give a handsome profit in terms of fresh fruit. If the oil price falls to $5.00 (United States currency) per pound, it will still provide plenty of incentive for the production in Mexico of sufficient limes to supply all requirements for lime oil in the United States and all requirements for fresh-lime shipments.

To process this quantity of fruit there are a number of plants. Seven are located in the State of Colima at Colima, and four more are reported under construction at other points; two at Apatzingán, one at Uruapan; and one at the Hacienda Nueva Italia in the State of Michoacán. On the southern coast of Mexico, at Acapulco, there are two plants, and two are reported to be in the southern part of the State of Veracruz; one at Tuxtepec, and one near Papaloápam. The last-mentioned is only starting production. There may be some further plant construction in the next few years, but it will probably be at a slower rate. There are 5 small plants in east-central Mexico, and fruit production in Tamaulipas, San Luis Potosí, and northern Veracruz may permit more work there within a few years' time.

Two types of lime oil are produced in Mexico: (1) Cold-pressed, and (2) distilled. Most oil is of the latter type. It is obtained by pressing the fruit through an expeller, or press, built on the screw principle, with a continuous intake. Passing through the expeller the fruit is crushed, the skins pressed, and the oil and juice flow out together. The liquor is conducted to stills from which the oil passes off for condensation. The cold-pressed oil is partly obtained by centrifuging the liquor as it comes from the press. A few plants have machines for extracting oil from the skins of the whole fruit. These generally follow the principle of those used in Sicily for producing cold-pressed machine oil from lemons. Generally they have not been designed or constructed for limes, and yields tend to be low. In the State of Colima about 10 percent of the oil is cold-pressed and 90 percent distilled. The proportion for the country as a whole will run less than 10 percent for cold-pressed. With the present high prices for distilled oil, there is little incentive to exert more effort and get less yield from the cold-press operation. In addition, cold-pressed oil requires care in extraction, which cannot always be given to it. At Colima, for example, only two out of the seven plants turn out the cold-pressed product.

Other Lime Products

The chief product of limes, apart from oil, is calcium citrate, which was first produced in Mexico at Acapulco in 1902. A number of plants turn out this product, using simple and rather rudimentary methods. So far the citrate has been utilized within Mexico, but the recent increase in production may make some amounts available for export under the emergency conditions of war.

Citric acid has not generally been manufactured, but one plant in Colima is now reported to be turning out a good product, which is consumed within Mexico. There is no expectation, in view of the additional equipment and technique required, that many additional plants will undertake its manufacture.

Pectin is not manufactured at all. Some interest has been manifested in the possibility of making this byproduct, but no one has yet started, and production probably will not assume importance for several years to come.

Orange Products

Only a few products are made from oranges in Mexico. Probably soft drinks, consisting of juice, oil, and citrates, constitute the principal manufacture. As a result of high prices prevailing in 1942, small amounts of orange oil were made in Mexico City. Fruit for this purpose was either whole fresh fruit shipped in or the skins of oranges from which the juice had been expressed. If prices become at all attractive in future years, the prospective larger output of fresh fruit in northern Mexico may encourage the establishment of byproduct plants.

The production of an essential oil new to Mexico was begun in 1942 by using the so-called sweet lime, or lima. Oil expressed from this fruit has been offered in the United States as Mexican bergamot. Stimulated by high prices for essential oils, it may have some chance of survival if it catches the fancy of the United States market. There are no commercial groves of this fruit, and it is not produced in large quantities, but it is relatively cheap and may provide a new product of some interest. Yields of oil run light, about 5 pounds per metric ton of fruit.

Future Production Possibilities

Production possibilities in Mexico for citrus byproducts depend chiefly upon the price situation. Under wartime stimuli every effort is being made to turn out more and more lime oil. Supplies of limes from relatively distant points are being drawn upon for existing factories, and some new plants are being built. Should prices fall substantially, possibly some decline in manufacture will result. The production of oils need not, however, be radically cut down because of probable changes in the production situation. New plantings of limes are expected to increase the supply of fresh fruit for the market. This fruit, either for export or for use within the country, will under normal conditions of demand and transport provide an excess of culls or small-sized fruit for byproducts. Any fall in the market prices for fresh fruit will result in cheaper supplies of raw material for making byproducts.

In most cases the machinery used in the manufacture of byproducts and the processes followed are relatively simple. In a few instances some efforts toward improvement are being made. Though there is room for this, doubt is expressed as to whether much change would be economical because, under normal conditions, returns for oil are not such as to encourage the installation of elaborate equipment or the use of fine technique.

As mentioned above, there may be substantially larger supplies of fruit within the next few years, a part of which, at least, will find its way into byproducts. Should additional fruit make larger plant operations possible, improvements may make for finer grade products and better extraction. Any such change would put Mexican manufacturers on a more competitive post-war basis.

TROPICAL FRUITS

Mexico produces a large variety of tropical fruits. Bananas, pineapples, and avocados need no introduction to people living in the colder climes, but many of the fruits most highly prized by the natives of tropical lands are unknown to inhabitants living in the Temperate Zones. Many of the fruits indigenous to Mexico are accepted as a matter of course and fail to command the same care and attention as are given to certain fruits that have been introduced. Oranges, pineapples, and bananas are laid out in orderly blocks or fields, with uniform spacing between plants. They are cultivated and receive much the same care as would be given them by any good grower in any country. Avocados, sapotes, mangoes, and papayas, however, are scattered about in dooryards, along the edges of cultivated fields and clearings, and even in the forests, where they are left to shift more or less for themselves. Most of these exotic fruits are looked upon by the Temperate Zone dweller as a luxury, and in a sense they are. Because of transportation difficulties, quarantine regulations, or other reasons, some of these splendid fruits may never grace the fruit stands or tables of United States cities or homes. If made available in such centers as New York, Chicago, or Boston, they would undoubtedly command fancy prices, but in the regions to which they are indigenous and in which they are grown in abundance, they form an important part of the poor man's diet. In season they are distributed over a large part of Mexico and are priced so as to reach a wide class of people. Pineapples and bananas, which form such an important part in international commerce, will be treated in detail, but to ignore altogether some of the lesser known fruits so familiar to the "Tierra Caliente" would be an injustice to the Mexican fruit industry.

The range of tropical fruits is confined largely to those areas bordering the Pacific Ocean and the Gulf of Mexico at elevations ranging from sea level to 4,000 feet. (See fig. 9.)

Veracruz, Oaxaca, Chiapas, Tabasco, pineapples, bananas, papayas, and sapotes are almost synonymous terms when speaking of tropical fruits.

BANANAS

That bananas did not exist in the Americas prior to the coming of the white man is generally conceded. At the same time, however, accurate dates of introduction by the early Spanish explorers are hazy. The best information is that gathered from the chronicles of the early historians and travelers. Two items appearing in the early books supply clues about the arrival of this fruit in the new world (5).

Oviedo, a Spaniard who compiled one of the first

FIGURE 62.-Basket of bananas and papayas in the market place.

natural histories of the New World, mentions that it was Friar Tomás de Berlanga who brought bananas from the Canary Islands to Santo Domingo in 1516. Since the Cavendish, or dwarf banana, is the principal variety cultivated in the Canary Islands, probably this was the fruit the Father carried with him. The above date was 5 years before the conquest of Mexico by Cortez.

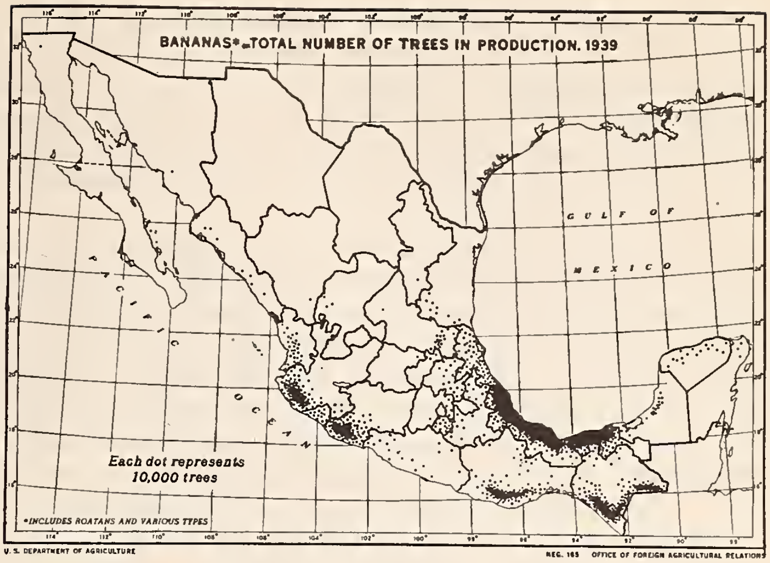

BANANAS*–TOTAL NUMBER OF TREES IN PRODUCTION, 1939
GULF OF MEXICO
Each dot represents 10,000 trees
*INCLUDES ROATANS AND VARIOUS TYPES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 165 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 63.-Map of Mexico showing distribution of bananas.

According to the Spanish historian Bernabé, two early voyagers, Sebastian Ramírez de Fuenteleal and Vasco de Quiroga are given the credit for the introduction of bananas to Mexico, which was reported in 1531. No mention is made of the variety of the plant. After that year, however, its dissemination and use rapidly increased. Fathers of the Franciscan order carried this fruit to many sections of the country.

As far as can be determined, the region near Córdoba in Veracruz was the scene of the first large-scale plantings. The establishment of plantings in this area was a natural choice because the Córdoba region lay along one of the principal avenues of entry to the central plateau. During the first 200 years of the colonial epoch (1521-1721) this zone remained an important supplier of the markets on the central plateau, particularly Mexico City. Today it still furnishes small quantities of fruit to domestic and foreign markets. Since 1900, the beginning of the important foreign trade in bananas, the chief producing centers have shifted farther to the south in Tabasco, Chiapas, and the southern portion of Veracruz.

The banana has unquestionably been an important source of food for Mexico. To the bulk of the population living on the central plateau, bananas constitute some addition to the regular diet of corn, beans, chillies, and rice. On the other hand in the sunny tropical regions this fruit is an actual staple. As one travels through the latter sections one rarely finds an Indian hut that does not have its own small patch of banana plants for home use. Many of the dishes of the coastal regions are prepared with the use of plantains.

Commercial Development

Bananas have been a common fruit in Mexico for generations, but plans were not made for the establishment of commercial plantings until the last decades of the nineteenth century and the first years of the twentieth. Gros Michel, or Roatan bananas, are believed to be the variety best known in the United States market. They were brought to Mexico by Manuel Jamet about 1880. The first bulbs were set out near Villahermosa on the banks of the Grijalva River in Tabasco, a State in southern Mexico that faces on the Gulf. While the plantings did very well and fair-sized bunches were obtained, Jamet did not meet with success in introducing the fruit to either the domestic or foreign market. At this time most of the railroad connections had not been established to southern Mexico and to ship bananas from the mouth of the Grijalva River by water along the coast to Veracruz, forward them to Mexico City, and have them arrive in an edible state proved an impossibility. Thus, the earliest efforts to get this industry started met with failure.

There is an interesting story connected with the origin of the name Roatan. It appears that before bananas were introduced into Honduras, the scene of the first plantings of Gros Michel in Central America, they had been previously produced on a small scale on the island of Roatan, which lies just off the mainland. A number of the producers in Tabasco state that Gros Michel or Roatan bananas were introduced into Mexico directly from the island of Roatan. The truth of the matter, however, seems to be that bananas were brought to Mexico directly from Honduras proper. The name Roatan is a carry-over from the original bulbs which were brought from the island to the mainland some years before.

The commercial industry did not get under way until 1895, when Julian Dueñas brought in more banana bulbs from Honduras. Dueñas had good luck in the cultivation of bananas. Soil and climatic conditions were of the best. Whereas his predecessor had been unsuccessful in opening up any kind of trade in bananas, Dueñas, who had visited the United States, immediately set out to interest North American businessmen in the possibilities of exporting this fruit from Mexico. His efforts were successful.

Vicente Mistretta formed the first exporting company, and during January of 1906 the first stems left Tabasco for the United States. In spite of the fact that little was known about methods of transportation and cooling in transit, most of the fruit arrived in Galveston, Texas, in edible condition. Gros Michel bananas were already known in the United States, but most shipments had moved to the eastern seaports. On arrival fruit was disposed of rapidly, and before the middle of 1906 a good deal of interest was manifested in bananas by fruit dealers in southern United States. In the summer of the same year the smaller company developed into the Southern Steamship and Exporting Company. Up to this time fruit had been moved to the United States and sold on the wharf. As business expanded and bananas enjoyed a wider consumption, a contract between Mistretta and the wholesale fruit dealers was made. This contract was signed in September 1906 and marked the real beginning of a very profitable agricultural industry for Mexico. These early shipments originated from the plantation "Saint Julian" near Villahermosa, the capital of Tabasco.

By 1910 some 350,000 bunches were leaving Mexico yearly. The year 1912 marked the first time that shipments exceeded 1,000,000 bunches, and by 1914 over 2,000,000 bunches were moving out of Tabasco to the United States. The increase in production and foreign sales was largely due to the efforts of Vicente Mistretta. For his efforts and success in the banana industry he was awarded a medal of honor by Porfirio Díaz, then the President of Mexico. In the early days of the industry ocean-going steamers were forced to lie off the port of Frontera, because a bar blocked the entrance to the river. A good deal of unnecessary labor resulted, and much time was lost because of the slow-moving lighters that brought fruit from the river to the steamers. Mistretta was one of the first men to plan for the creation of a deep-water canal into Frontera, the chief seaport of Tabasco.

A scarcity of ships caused by World War I brought about a great decrease in exports. From the 2-million mark in 1914 exports decreased by 1,700,000 bunches, and in 1917 only 300,000 bunches moved from the Republic. Banana shipments did not reach 1,000,000 bunches again until 1921. From 1921 to 1928 exports moved upward at a relatively slow pace. The completion of the deep-water canal at Alvaro Obregón in 1928 - the same canal that had been started in 1912 - made for ease in the loading of fruit. The decade following 1930, especially from 1934 to 1940, marks the high-water mark of banana exports from Tabasco. In 1936 about 6,900,000 moved from this one State to foreign markets.

When it became evident that the exportation of bananas was a profitable venture, other regions within Mexico began to manifest interest in planting and exporting this fruit. About 1916 the region near Papaloápam and Tuxtepec, which is about 100 miles to the south of the port of Veracruz and some 60 miles inland from the Gulf of Mexico, began to open. The present important growing area of Chiapas, which lies immediately to the north of Tapachula, was started about 1922. The banana regions of the Nautla and Tecolatla Rivers in northern Veracruz were planted about 1928. While plantains and other types of bananas had been growing in the Córdoba area for centuries, plantings of Gros Michel did not get under way until the latter years of the 1920's.

Value of Production

From 1910 until 1940, when the banana disease, sigatoka, became a great menace, Gros Michel bananas, from the point of view of value, constituted the most important fruit crop in Mexico. In 1940, however, Gros Michel bananas forfeited the leading position insofar as value was concerned. The orange crop for that year was valued at some 16,000,000 pesos (about $3,000,000) against 10,000,000 ($1,855,000) for that of Roatan bananas. The latter figure is less than one-half the value during the peak year of 1936 of 23,000,000 pesos ($6,400,000). During 1940-42 mangoes, avocados, limes, and pineapples began to move up the scale and are now challenging bananas. If and when sigatoka is really controlled in Mexico, bananas should once again occupy first position.

Agriculturally speaking, the banana has meant more to Mexico in export sales than most other domestically produced crops. In the line of fruits it has been by far the most important. Pineapples and limes still play a poor second and third. From a monetary point of view, all through the 1930's it ran a close race with henequen for top position in agricultural exports. Now it has given way to both cattle and henequen.

Volume of Production

Production of Gros Michel bananas reached its zenith in 1937, when 578,167 short tons were produced in Mexico. During 1927-34 production averaged about 265,000 tons yearly. The first real increase took place in 1933, when 288,576 tons were produced. Although sigatoka arrived in Mexico in 1937, production was not immediately affected. In 1938 and 1939 it was still holding up fairly well. In 1940, however, the first marked decrease took place. Production slumped to 297,645 tons and to 262,205 in 1941. Preliminary data indicate a slight increase for 1942 to about 300,000 tons. Mention should be made that the above-cited production figures are based on official data of the Mexican Department of Agriculture. In comparison with data obtained from the banana trade, however, they appear to be on the optimistic side. Especially is this true of the estimates since 1937, which are believed by the trade to be high and to need discounting by 10 to 15 percent.

While the production of Gros Michel bananas has shown a definite decrease since 1937, official data indicate that the output of other varieties of bananas has shown

TABLE 9.-*Acreage in production, number of trees, average yield per tree, and production of Gros Michel and other varieties of bananas in Mexico, 1927-42*

YEAR	GROS MICHEL				OTHER			
	AREA	TREES	YIELD	PRODUCTION	AREA	TREES	YIELD	PRODUCTION
	Acres	*Number*	*Pounds*	*Short tons*	*Acres*	*Number*	*Pounds*	*Short tons*
1927	26,210	4,242,674	103.62	219,773	19,805	3,205,926	70.55	113,366
1928	29,084	4,708,093	101.41	238,955	21,918	3,547,878	70.55	126,760
1929	31,078	5,030,978	99.21	251,246	23,757	3,845,404	68.34	132,384
1930	32,460	5,254,279	101.41	268,843	21,162	3,425,435	70.55	119,261
1931	31,194	5,049,570	99.21	248,704	21,365	3,458,465	68.34	116,651
1932	28,353	4,589,535	99.21	226,166	25,998	4,208,202	57.32	120,691
1933	37,083	6,002,702	97.00	288,576	28,620	4,632,830	44.09	105,105
1934	47,451	7,681,279	97.00	374,067	30,386	4,918,977	55.12	133,762
1935	62,710	10,151,139	94.80	485,612	27,886	4,964,187	61.73	138,710
1936	75,337	12,195,047	90.39	550,259	29,608	4,792,971	57.32	135,238
1937	84,722	13,714,214	83.77	578,167	29,699	4,807,701	55.12	133,806
1938	72,891	11,799,231	97.00	571,449	29,766	4,818,315	57.32	137,629
1939	68,833	11,142,310	99.21	558,548	32,408	5,246,098	57.32	148,212
1940	50,063	8,104,060	72.75	297,645	32,714	5,295,651	55.12	144,675
1941	47,187	7,638,543	68.34	262,205	35,613	5,764,959	52.91	150,255
1942[1]	46,974	7,604,135	79.37	299,828	38,889	6,295,188	48.50	153,136

[1] Subject to revision. Preliminary forecast. Acreage calculated on basis of 400 trees per hectare (2.5 acres).

Compiled from official sources.

a steady rise, even though subject to infection by sigatoka. For example, production of other types of bananas in 1932 amounted to 120,691 short tons; by 1942 it had reached some 153,000 tons. Unlike Gros Michel, which showed phenomenal rises from 1934 to 1938, other varieties of bananas moved forward very slowly. The arrival of sigatoka in Mexico has not caused proportionate losses to other varieties, such as Cavendish and plantains, as has been true with Gros Michel. Apparently, Cavendish and plantains are not so susceptible to the disease.

Location of Industry

According to data issued by the Mexican Department of Agriculture, Gros Michel bananas are produced in 23 different States. They grow as far north as the States of Chihuahua and Tamaulipas, both of which border on Texas. Sonora, which borders on Arizona, also has a small production. Bananas in all these States are of minor economic importance, and the harvest serves neighboring communities only. The bulk of Mexican production is concentrated in the south in the States of Veracruz, Oaxaca, Tabasco, and Chiapas. Before expropriation, the State of Jalisco, on the west side of Mexico, in the Central Zone of the Republic, was also an important producer.

Before the arrival of sigatoka and the beginning of agrarian troubles, Tabasco was by far the leading producer. It was followed by Veracruz, with Chiapas in third position and Jalisco making a poor fourth. At the present time this order has been completely altered. Chiapas leads; Veracruz still holds second place, although production is extremely curtailed; and Jalisco has completely passed out of the picture as far as exports are concerned. From the middle of 1941 and all during 1942 production and foreign sales were virtually paralyzed in Tabasco. Until the closing weeks of 1942 not a single stem had left this State for the United States market, as compared with 6,900,000 stems in 1936.

During the month of January a field survey of the banana-growing areas of Veracruz, Tabasco, and Chiapas was made. At that time scattered regions in Veracruz were forwarding fruit to both domestic and foreign markets, the smaller portion going to the latter. Since the districts are widely separated and there is no one large concentration of plantings that would warrant extended investigation, only those parts readily accessible from the Pan-American Railway were visited. Among these were Córdoba, Tuxtepec, and San Andrés Tuxtla.

In the latter half of 1942 attempts were under way to regain a place for Tabasco as an exporter of bananas. Spraying machinery and chemicals were purchased to initiate a campaign against sigatoka, which had laid waste the plantations of that State. Still, at the close of the year, only 4 cars of exportable fruit were available for movement to the United States. At this time Tabasco appeared to be on the way toward regaining its former prominence, but forecasts appeared immature. The situation was reviewed with interest, but since the control programs of the State were in their infancy, it was considered wiser to make a more exhaustive study of conditions in Chiapas, which had managed to place in effect a disease-control program that was producing real results. Moreover, Chiapas had swung into the lead with respect to foreign shipments, supplying fully 50 percent of the total.

Chiapas – Leading Producer

Because Chiapas has managed to forge into the lead in this agricultural commodity, it has been chosen for detailed review. This State occupies the extreme southwestern corner of the Mexican Republic. It is bordered on the north by Oaxaca, on the east by Tabasco, on the south by Guatemala, and the western portion fronts on the Pacific Ocean. Except for a narrow coastal plain, which varies from 2 to 25 miles in width and extends the entire length of the western portion of the State, it consists of an elevated highland. The highland region begins to rise at the Isthmus of Tehuantepec and reaches a height of some 5,000 feet. It continues beyond the southern frontier of Mexico on to Guatemala and Honduras. A large portion of the soil of the upland territory is of volcanic origin, and that of the coastal belt is of an alluvial character, having been deposited by streams that flow from the coastal range to the Pacific Ocean. From an agricultural point of view, the principal crops are coffee, corn, beans, cacao, livestock, and bananas. Of these, the banana runs a close race with coffee for top position.

Banana production is concentrated along the coastal plain from Suchiate, the exit point on the Guatemalan border, to Mapastepec, about 75 miles to the north. Plantations are located along the Pan-American Railway that runs south from the seaport of Veracruz to Guatemala City. This railroad provides the only avenue for foreign and domestic movements. In times past small amounts were shipped by ocean vessels, but export through this channel is precluded until hostilities cease. In the banana belt the coastal plain varies in width from 10 to 25 miles. Only a small portion of it is devoted, however, to agricultural production. Banana plantings for the most part are situated on the level lands at the base of the coast range. Probably this fruit would do well anywhere on the plain, but proximity to the railroad and plentiful water supplies near the mountains have made for the present location of the industry.

The over-all average height of this region is some 180 meters (about 594 feet) above sea level. The lowest growing point is at Acapetahua, which is about 23 meters (75 feet) above sea level. The highest elevation at which bananas are planted is at Cacahuatan, 360 meters (1,188 feet) above sea level.

The banana district of Chiapas is the only important banana-growing area situated on the west coast. Formerly the region near Puerto Vallarta, Jalisco, some 800 miles to the north, also exported fairly sizable amounts of fruit. Weather conditions in these west-coast banana areas are quite different from those in Veracruz and Tabasco.

TABLE 10.–*Number of bearing trees and production of Gross Michel and other bananas in Mexico by State, 1931-41*

STATE AND VARIETY	NUMBER OF TREES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
Gros Michel:										
San Luis Potosí	3	4	4	5	4	176	182	231	250	223
Tamaulipas . . .	4	5	3	1	1	149	150	90	23	11
Campeche	128	108	81	64	55	4,938	4,762	3,393	2,489	2,343
Quintana Roo . .	1	1	1	1	1	55	53	51	53	53
Tabasco	4,411	2,845	984	331	51	131,273	125,435	43,402	10,945	1,513
Veracruz	3,659	3,414	3,837	3,184	3,711	169,382	161,813	190,324	87,741	106,352
Yucatán	5	5	9	8	8	231	198	330	314	255
Nayarit	43	44	47	49	64	1,651	2,028	2,064	2,102	2,751
Sinaloa	15	13	—	—	—	331	287	—	—	—
Colima	81	68	68	57	17	2,665	1,724	1,724	2,155	412
Chiapas	3,075	2,783	3,597	2,741	2,515	152,536	144,192	186,367	108,763	97,024
Guerrero	22	23	23	20	18	1,117	1,023	944	809	708
Oaxaca	1,856	2,070	2,084	1,259	832	92,049	107,243	107,972	62,460	32,114
Hidalgo	4	5	4	6	6	194	236	172	245	249
Jalisco	383	386	375	351	331	20,259	20,865	20,266	18,169	17,128
Michoacán . . .	16	17	15	14	14	819	836	764	586	632
Puebla	8	8	10	13	11	342	422	454	541	437
Total . . .	13,714	11,799	11,142	8,104	7,639	578,167	571,449	558,548	297,645	262,205
Other varieties:										
Coahuila	—	—	(1)	(1)	(1)	—	—	4	5	5
Chihuahua . . .	1	1	1	1	1	7	9	9	9	27
Durango	10	11	14	14	15	303	355	448	447	442
Nuevo León . . .	11	11	7	7	8	286	303	211	207	235
San Luis Potosí	145	142	148	162	163	3,619	3,529	3,856	3,913	4,478
Tamaulipas . . .	72	73	85	83	82	1,847	1,876	2,266	2,223	2,117
Zacatecas . . .	19	20	28	27	26	405	458	610	614	623
Campeche	71	76	65	65	63	2,386	3,008	2,959	2,830	1,779
Quintana Roo . .	14	15	20	19	19	502	502	565	538	538
Tabasco	113	86	90	100	101	3,152	2,301	2,400	2,441	2,519
Veracruz	1,263	1,180	1,253	1,223	1,316	33,304	31,924	31,719	30,694	33,369
Yucatán	148	109	129	94	139	4,001	3,003	3,425	2,488	3,399
Baja California	5	5	5	7	7	140	135	105	166	181
Nayarit	201	210	231	230	257	5,848	6,113	6,243	6,310	5,771
Sinaloa	42	41	44	46	61	1,046	1,025	1,103	1,146	1,421
Sonora	8	8	7	7	7	219	215	218	216	218
Colima	67	64	59	57	31	2,381	2,483	2,276	2,083	1,061
Chiapas	437	433	450	440	717	14,881	14,767	15,782	14,857	16,292
Guerrero	132	147	138	147	163	3,726	4,596	4,409	4,464	4,135
Oaxaca	320	368	408	436	503	8,630	10,122	10,766	9,246	11,507
Guanajuato . . .	7	7	8	10	15	185	183	189	214	189
Hidalgo	106	106	149	157	145	2,551	2,844	3,599	3,783	3,086
Jalisco	594	607	605	611	573	16,342	16,714	19,369	19,534	17,788
Mexico	49	50	51	53	53	1,275	1,282	1,210	1,434	1,394
Michoacán . . .	711	765	932	951	935	20,478	22,615	26,767	26,584	29,215
Morelos	106	108	122	136	139	2,518	2,637	2,897	3,123	3,157
Puebla	140	159	182	198	211	3,372	4,228	4,416	4,715	4,916
Querétaro . . .	16	16	15	15	15	402	402	391	391	391
Total . . .	4,808	4,818	5,246	5,296	5,765	133,806	137,629	148,212	144,675	150,255

[1] Less than 500.

Compiled from official sources.

The most marked difference in climate between the eastern and western seaboard is the long dry spell on the latter. Chiapas has a pronounced dry season that begins in the early part of December and continues to about April 15. An average of only 2 days of rain per month occurs during December, January, February, and March. Humidity in the winter dry period runs a good deal under that of the rainy months. During September, the month of heaviest rainfall, humidity reaches about 74 percent, as compared with some 60 percent in the dry months. Also, the highest temperatures occur during March, April, and the first part of May. April is the warmest single month; a 20-year record kept by the Mexican Meteorological Service gives a mean of 80.9° F.

Contrary to widespread belief, the banana area of Chiapas has a much heavier yearly rainfall than is true of Tabasco. Rainfall is generally concentrated in a shorter span of months than is true of the banana regions of Tabasco. According to rainfall statistics compiled by the Meteorological Service at Tapachula, the over-all average for 20 years was 90 inches. On the other hand, average yearly rainfall at Villahermosa, in the heart of the banana district of Tabasco, for the same period amounted to only 83 inches. The rainfall commences to be heavy in June and continues until the middle of October. June, September, and October have the heaviest precipitation, which averages about 17 inches per month.

The well-defined dry season in Chiapas has its drawbacks as well as its advantages. Because of the very dry winter months, particularly from January to the middle of April, irrigation is necessary. In order to divert water from the streams that flow from the mountains behind the banana district a good deal of work and a rather large investment of money are necessary. Especially is this true when new lands are being developed. The extra money expended for the purpose of irrigation, however, is compensated for by the dry weather, which serves to hold in check the inroads made by sigatoka.

Sigatoka spreads much more rapidly during the wet humid months than in the dry ones. During the dry months the humidity in Chiapas reaches such a low percentage that sigatoka is practically held in abeyance without the use of sprays. In fact, on a number of the plantations that have never used spraying equipment, banana leaves are mostly green and do not have the characteristic brown blotches that are indicative of infection. Contrary to the situation in Tabasco, where spraying must be carried on all the year around, growers in Chiapas do not spray at all from December to the middle of April.

Types of Farms. Plantings of bananas in the southwestern portion of Chiapas are concentrated along the Pan-American Railroad. Most of the plantations border the railway and seldom are found at distances greater than 3 to 4 kilometers (about 2 to 2.5 miles) from the loading stations. As one flies over the area, the plantations appear to form a great, broad, green highway, divided in the center by the railroad.

The heaviest concentration of plantings is at Acapetahua, which is some 45 miles to the north of Tapachula. Huixtla, Soconusco, and Tapachula are the other important growing centers of the State. These four towns probably account for some 80 percent of the total production.

Most of the producers, both large and small, own the land they cultivate. No single producer cultivates the total 330 hectares (825 acres) that he is allowed under Mexican law. In fact, the largest individual grower has only 140 hectares set out in bananas. The amount of top-quality banana land in this section of Chiapas is limited, although certainly a much larger portion of land could be made available if growers wished to expand. Two factors have a limiting effect upon the size of plantings. The first is the difficulty of transporting the fruit from the field into the loading station. The fact that almost all the bananas are hauled from the field to the railway by oxen precludes a grower from having a plantation more than 5 kilometers (3 miles) from the shipping point. Trucks thus far are the exception and not the rule. A second, and possibly the more potent, factor is the problem of water supply for the irrigation of mats during the dry season. In certain sections of the district disputes over riparian rights have become acute. Especially has this been true during the recent years, when the development of the agrarian program has progressed so rapidly that necessarily it has had a deep effect on all phases of Mexican agricultural economy - and, of course, markedly so, as would be the case in any country, in the matter of water. When it becomes possible to approach the water-right question in a scientific manner and a survey is made to determine the actual amount of water available during the dry months, a just and workable solution can be effected.

Soils. The soils of the banana region of Chiapas are alluvial in nature, having been deposited by the streams which flow down from the coastal range. On those plantations, which lie at the base of the mountains, a sandy soil with a fair amount of gravel is characteristic. On several plantations a clay loam is found. At Acapetahua, in the heart of the district, the soil is made up of a light sandy silt loam that is many feet deep. Because of the sandy character of the soils water does not generally remain on the surface for extended periods. Even after a heavy rain puddles disappear within a few hours.

Varieties. By far the most important variety of bananas grown in Chiapas is the Roatan or Gros Michel. Since this variety is the one for which there is the greatest demand in the foreign market and brings the best financial returns, little attention is paid to other bananas. Moreover, it is the best variety for eating and shipping. Small plantings of plantains are usually found alongside growers' homes, but these have little commercial importance. They are generally for domestic use. The *ejidatarios* of this region have grown cooking plantains on a wider scale than the larger producers. The quantities of plantains

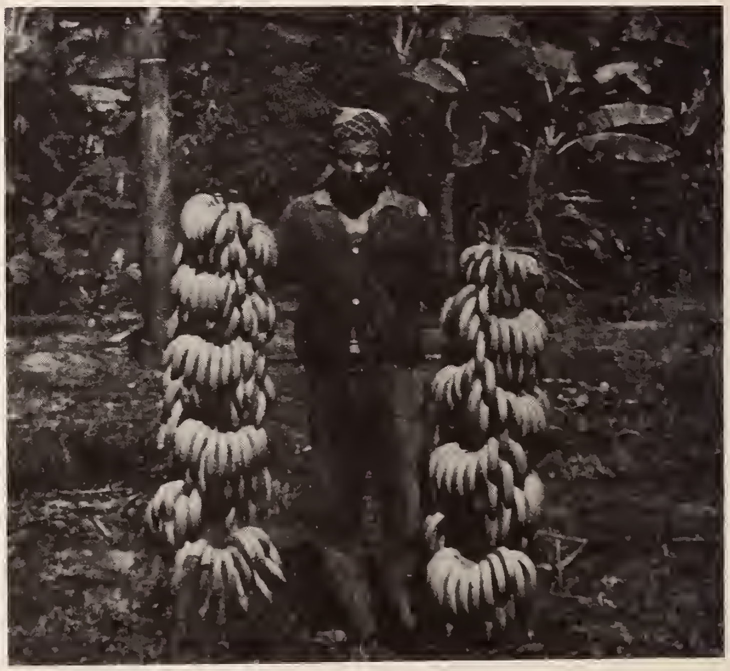


FIGURE 64.-Nine- and 11-hand stems of Roatan bananas in Chiapas.

forwarded from Chiapas to central markets, however, are small in size. Probably the *ejidatarios* have shown more interest in plantains, because they are less subject to sigatoka and, moreover, furnish an important staple in their daily diet. In addition to the above-mentioned varieties, small quantities of Lady Finger and Manzano bananas are grown. These may be purchased in the local market but are rarely shipped outside the State.

Cultural Practices. When new land is opened for the planting of bananas, soil preparation depends upon the type of native vegetation that is found growing on the site selected. Generally the land is covered with forest and a heavy tropical underbrush. The first step is to survey the area and select those trees which will net the producer some cash return. While these trees are being felled, another group of workers is busy cleaning out the underbrush. This last process is usually accomplished with a machete. After the trees with valuable lumber are removed, the underbrush cut, and the remaining useless trees felled, the land is usually burned over. Some growers prefer not to burn; they clear out the underbrush and then fell the trees, which are left to decompose by themselves, a process which takes place fairly rapidly in the hot humid tropical regions. Other growers prefer to stake out the land first and then set out the banana bulbs. The last step is to fell the trees, which causes only a temporary set-back to the young banana plants.

Generally speaking, seeds are rarely developed in the cultivated varieties of bananas. Thus, the planting is done with rootstocks or rhizomes. Planting material originates from adjacent plantings of the producer or from nearby plantations. Most planters exercise a great amount of care in the selection of planting material. Usually heads, which are at least 6 inches in diameter and which have at least one good eye, are selected. Indiscriminate planters sometimes split individual heads to make the planting material cover a greater acreage. Unless the area to be planted is very fertile, a poor selection of rootstocks produces a smaller mat, which results in a decreased yield of marketable fruit.

When the planting material has been hauled to the field, it is placed in holes which are from 14 to 18 inches deep. The part of the rootstock with the eye is generally placed toward the bottom of the hole. The holes are spaced at distances varying from 16 feet to 20 feet apart. Generally the distance in planting varies in relation to the class and fertility of the soil. At times in the past plantings appear to have been established with a minimum of foresight. For example, in some of the older fields near Tapachula mats are spaced as closely as 9 feet. In many instances removing every other plant has been necessary. The belief is that the overall average is about 16 feet apart in this district, which makes for some 350 mats per hectare (2.5 acres). The usual months for planting are in April and May, just before the regular rainy season begins.

A newly set out field is usually so covered with tree trunks and piles of brush that it looks much like a part of the jungle itself. When the young plants first appear, they are hard to distinguish from the grass and weeds, which grow with lightning rapidity. These fast-growing weeds and grass are termed "monte." During the first year a constant battle is waged to keep ahead of the native vegetation. Workers with machetes are continually in the field cutting and cleaning. Until the growth of weeds and grass is dominated, fields have to be cleaned from five to seven times. This naturally depends upon the vigor of the native vegetation. After about six

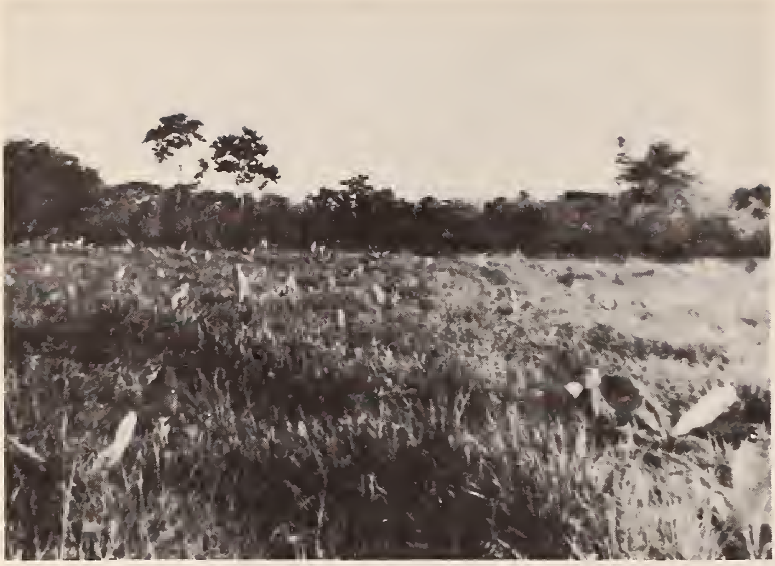


FIGURE 65.-A 4-month-old banana plantation at Tapachula showing heavy competition with weeds and grass.

cleanings and when the trees have reached a height sufficient to cast a large amount of shade, the "monte" problem is held in check.

At the same time that clearing is taking place, much attention must be given to the growing plants. As is true with the "monte," the banana plant develops with incredible rapidity. Suckers from the parent trunk often appear, and in the early stages these must be cut in order that the strength may not be sapped from the main stem, which will produce the fruit. After the parent stalk reaches a good height, three of the healthiest suckers or shoots are allowed to develop. These, with the parent stalk, form a plant mat. Until the mat is no longer productive, this group of trunks is always maintained. After the shoot produces a bunch of bananas, it is cut out, and a new one is allowed to take its place.

Once the plantation is in production, individual owners follow distinctive methods of cultivating and keeping the fields clean. For the most part little attention is paid to cultivation of the fields. Most owners maintain workers continually to cut away the old banana leaves and cut back vines from the mats. After the plantation has reached its full height, not a great deal of trouble results from grass and weeds, but a vine common to Chiapas causes considerable damage. At times it completely engulfs an individual mat.

Most of the plantations are far from being as clean as the average orchard in the United States. One of the best looking plantations visited lay outside of Tapachula. This particular owner took extremely good care of his plantings. As soon as a mat was found with a dead leaf, the latter was cut. But he was the exception in the district. Most of the other growers made efforts to trim back the heaviest growths of dead leaves and vines but left their fields in a generally dirty and cluttered-up condition.

As far as is known, there are only half a dozen growers who cultivate regularly. Most of these use oxen to draw the cultivator. Only one producer was found who used a modern tractor and, while his fields were remarkably clean in comparison with those of his associates, the yields obtained were no larger. The use of fertilizers is not general in Chiapas.

Irrigation and Drainage. As mentioned previously, growers in Chiapas must supply water during the winter dry season, which lasts some 5 months. Water for irrigation purposes is obtained by tapping one of the numerous streams that originate in the coastal range immediately to the east of the banana area. For the most part water supplies have been in sufficient abundance to take care of the growers' needs. In certain instances disputes have arisen that have forced some growers temporarily to give up cultivation.

Irrigation is accomplished by cutting four ditches through each hectare. Because of the sandy nature of the soil, water passes from the ditches to the mats by infiltration and not by direct flooding of the land. As one walks through the plantings one notices that the soil is fairly dry to a depth of about 4 inches, but the portion below this is heavy with moisture.

The irrigation system of this area never stops functioning during the dry season. The water must be kept running constantly. Any cessation causes a set-back that is readily discernible. Irrigation begins in the middle of December and ends about the first of May. The usual policy is to cut off the water about 2 weeks before the.regular rainy season arrives. Growers explain that high winds accompany the first rains, and if the soil is full of moisture, trees are more apt to topple than if the ground has had some opportunity to dry out.

During the rainy season the irrigation ditches serve to drain off excess water. Every 5 to 7 acres are intersected with a large central ditch that in turn leads into the main canal, which brings and takes all the water to and from the planted area.

The Sigatoka Disease

Without question the most serious disease affecting the banana industry is sigatoka. It was the most important factor causing the downfall of the industry. Two other factors have added, however, to the difficulties encountered. As pointed out above, the progress of the agrarian program has been so rapid as to cause certain conflicts in the economic structure of Mexican agriculture. This is one of the factors affecting the banana industry; another is the present world conflict.

The expropriation of large land tracts was instituted in 1934, when Cárdenas became President of Mexico. This plan of dividing up the large haciendas held both by nationals and foreigners moved slowly during 1935 and 1936, but this action on the part of the Mexican Government quite evidently spelled trouble for the large banana

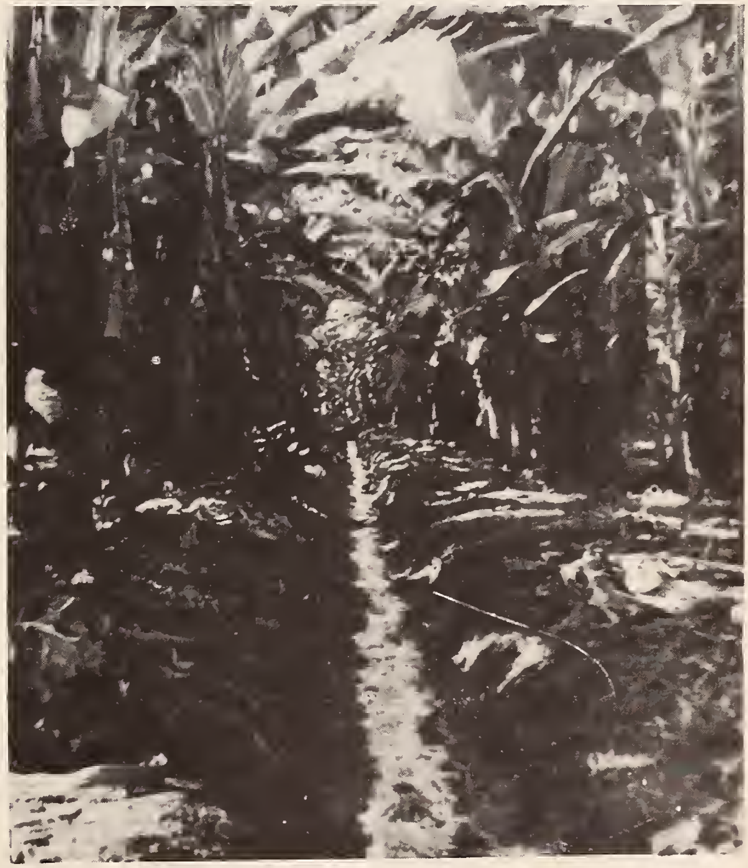


FIGURE 66.-Irrigation and drainage canal at Tapachula, Chiapas.

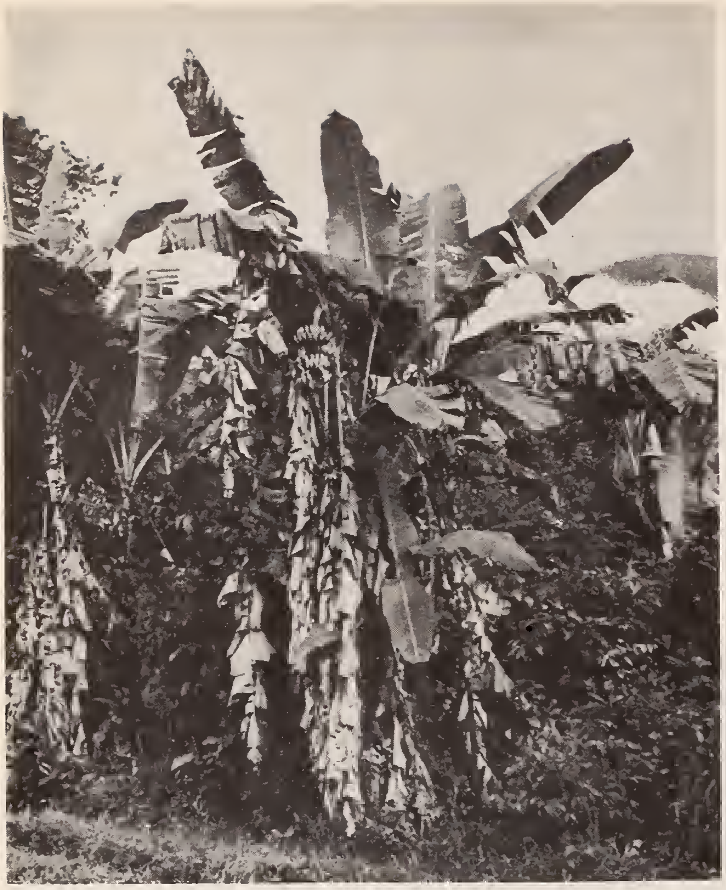


FIGURE 67.-Banana tree in Cordoba showing heavy infection of sigatoka. The stem contains but 5 hands, and all fruit is much reduced in size.

companies. At the zenith of the expropriations and the height of agrarian troubles, sigatoka made its entrance into Mexico.

This fungus disease arrived at the mainland of Central America about 1935. Reports state that it was carried to countries below Mexico from Trinidad, or one of the other banana-growing islands of the Lesser Antilles. Its effect and progress were rapid in the Central American republics. The large fruit companies, which operated in these countries, immediately began investigation and formulated plans for its control.

When sigatoka was first noted in Mexico in 1937, Tabasco, then the most important producing State, was the first affected and undoubtedly was hit the hardest of all the producing regions. While the disease caused damage from the outset, plantations were not immediately crippled. According to the accounts of the banana companies, production decreased at the rate of some 20 percent each year. This does not agree, however, with the official statistics published by the Mexican Department of Agriculture, which reports the decrease at a much slower pace.

The year 1938 saw sigatoka become firmly entrenched in the banana-growing regions of Veracruz. San Andrés Tuxtla was badly hit as were the banana plantations located on the Papaloapam River and its tributaries. In the far north of the same State the effect of the disease was less severe. In the northern areas of Tecolatla and Nautla production remained fairly constant until 1939. Although the fungus arrived at the Córdoba district in 1938, its usual devastating effects did not and have never caused the same damage as in the other districts. Probably this smaller degree of infection can be attributed to a cooler, less humid climate.

Chiapas first became aware of sigatoka in 1938, but, as already mentioned, the disease never became so grave a problem on the west coast as on the eastern. The long dry season in the winter together with a lower percentage of humidity have served in part to hold the disease in check. There still remains one area in Mexico where the disease has caused only slight injury. This district is that of Puerto Vallarta, Jalisco, located some 900 miles to the north of the Chiapas region on the Pacific coast.

As the disease increased, stems became smaller and the individual fruits more slender in form. Production for the whole country fell from the 1937 figure of about 525,000 metric tons (580,000 short tons) to some 240,000 (260,000) in 1941. These are data from official sources, and, as mentioned already, the decline probably has been more marked. Although exports from Tabasco ceased altogether, other districts continued to export but on a greatly reduced scale. The contrast is interesting between the record high of total exports in 1937 of 14,750,000 stems and the foreign movement of 1941, which amounted to only 5,160,000 stems.

As previously pointed out, conditions in the rural districts were undoubtedly in an unfortunate state in 1937. At a time when all-out cooperation was called for, an upheaval was taking place. There was no cooperation among the growers, the banana associations, and the large companies. To carry out any type of investigation and to institute successful disease-control measures were out of the question, just when the technical assistance of the companies was most needed, and the cooperation of the growers and associations was necessary to put the findings of the technicians into effect. Yet, cooperation in the circumstances was not only unlikely but probably impossible. As one might expect, the companies began to withdraw from all growing and marketing operations.

Tabasco admittedly offered one of the most ideal sites in the world for the growing of bananas. Climate, soil, and transportation facilities were of the best. For the most part growers expended a minimum amount of effort and received a maximum amount of production from their plantings. Things had moved along smoothly. Aside from some trouble with rodents, plantations had developed and produced without serious difficulties. To have a grave disease, which not only affected a few plantations but which moved steadily to wipe out most of the fields, offered a problem that growers were unable to solve readily.

Control Programs. In the year of the advent of sigatoka into Mexico, some preliminary discussions started regarding control and spraying programs. Because of the agrarian situation, however, nothing was done. Yearly meetings continued to be held and the problem reviewed. Yet up to the end of 1941 no active spraying and control program was under way. Only a few of the growers had begun to experiment with spraying equipment. Their efforts had little effect on the rehabilitation of this crumbling industry. Some efforts were made to dust the plants. This likewise proved of no consequence.

Finally, when a decision was made to take concrete action and attack the problems in a scientific manner, the growers were confronted with a war. Water-shipping facilities were no longer available. This meant that all foreign movement of fruit had necessarily to move by rail. Moreover, any kind of control measures required large amounts of chemicals and a good deal of mechanical equipment. Mexico was not in a position to supply either of these. Aside from lime for making Bordeaux mixture, all the remaining needs had to be imported. Both chemicals and all types of machinery were needed for war purposes, which made for difficulty in getting under way.

Mexico was in a unique position as far as its geographical position was concerned. Except for Canada, it was the only country that could forward its agricultural commodities to the United States by rail. Of course, because of existing rail difficulties within the country, one could not expect to move the same quantity of fruit as in former years. Yet its fruit could move when that of the other banana countries could not because of a necessary dependence on ocean shipping.

Chiapas was the first State to start a successful spraying program. In the latter part of 1941 one of the more progressive growers of the State, Manuel David, of Acapetahua, brought two sprayers from the United States. He immediately began to conduct experiments, which proved effective. Soon his plantation was in a position to forward graded stems of 8 and 9 hands to the foreign market. His neighbors, also planters, took an interest and asked that he bring in machines from the United States for their use. Within a short time his plantation became the center of information regarding new control methods. David, whose first interest is in his plantation, decided that he could not successfully handle the importation of equipment and look after production problems properly at the same time. Moreover, to finance such a program required a considerable sum of money, which a commercial institution was more capable of furnishing.

In 1941 the semigovernmental bank, Banco de Comercio Exterior, opened an office at Tapachula and began to operate in coffee, with some success. This institution then expressed its interest in participating in other agricultural fields. David therefore turned his sales agency for banana-spraying equipment and chemicals over to this organization. The bank extended loans to help other producers obtain the needed machines and chemicals. At the same time it established a selling agency composed of representatives of the bank as well as delegates from each of the four large grower cooperatives.

In this manner the banana industry of Chiapas began to regain its footing. Banana movements to both the foreign and domestic markets began to expand. Early in 1942 about 30 cars were leaving this State each week. By the close of the same year about 100 cars were moving out weekly. The spraying program really made for an improved position. One should recall, however, that only some 26 growers were exporting. As mentioned previously, this number constitutes only a small percentage of all the persons engaged in the cultivation and sale of this fruit.

Methods of Control. Because of the life cycle of the fungus, sprayings are necessary every 21 days during the rainy season. If a grower wants to do a good job, he must apply Bordeaux mixture regularly, the preparation that is used to check the inroads of sigatoka. Usually one application is made before the start of the rainy season in May and two applications following the close of the rainy period in December.

The sum of money which the bank invested in chemicals and spraying equipment was a considerable one. In order to insure its investment, the bank appointed technicians to travel up and down the district, checking on the individual producers. According to instructions supplied by the bank, a total of 14 sprays should take place yearly, but actually the average number of applications runs closer to 11.

The spraying machines brought to Chiapas are of two sizes. To persons with larger plantations the bank sells a machine with a tank capacity of 300 gallons. To the smaller growers machines of 150-gallon capacity are sold. Both sizes are equipped with gasoline-driven motors. The spraying equipment is hauled through the fields by oxen. The machines are equipped with two leads of hose.

The smaller machine has a potential top pressure of 400 pounds and that of the larger is 600 pounds. The average pressure used is about 300 pounds. The machine may be regulated, however, to work at any pressure from 1 to the maximum listed by the manufacturer. Since spare hose are very difficult to obtain, the pressure is kept at the lowest point possible. Most of the spare parts have to be imported from the United States. Growers have managed to obtain hose, plungers, and at times extra cylinders of domestic manufacture.

Usually around 5 liters (about 5 quarts) of Bordeaux mixture are applied to each mat per application. At this rate some 55 liters, on the average, are applied to each mat yearly. In January 1943 about 460,000 mats were being sprayed regularly to control sigatoka. This number of mats covers about 1,340 hectares (about 3,300 acres). The bank indicated that it expected to turn over additional equipment and chemicals for the control of some 300,000 more mats. In 1942 a total of 462 metric tons (about 509 short tons) of copper sulfate were brought into the State for control measures. Most of this quantity originated in the United States, and a very small portion was produced in Mexico.

As one travels through the region, spraying operations appear to have brought about some good results. At the same time, however, some growers feel that they are not going ahead with the program on a sound scientific basis. A few of the more progressive ones have requested that an experimental station be established to check on present operations and to try to devise better control methods. To date nothing has resulted from these suggestions. In order to compete successfully with the bananas grown in the Central American republics after the close of the war, something more than trial-and-error control methods must be put into operation.

Harvesting Methods

The harvesting of bananas is a continuous process that takes place during every month of the year. The only variation to the foregoing statement is that in certain months production runs heavier than in others. Production begins to increase with the beginning of the rainy season and reaches its height during August, September, and October. On a percentage basis, the dry months produce about 80 percent as much fruit as do the wet months. Also fruit that matures during the rainy season is larger, and the stems run to greater size.

Bananas are harvested when three-quarters ripe and in the following manner. A worker with a sharp wide-bladed knife attached to the end of a long pole partially severs the trunk at a point just below the stem or about 10 to 12 feet above the ground. Considerable skill

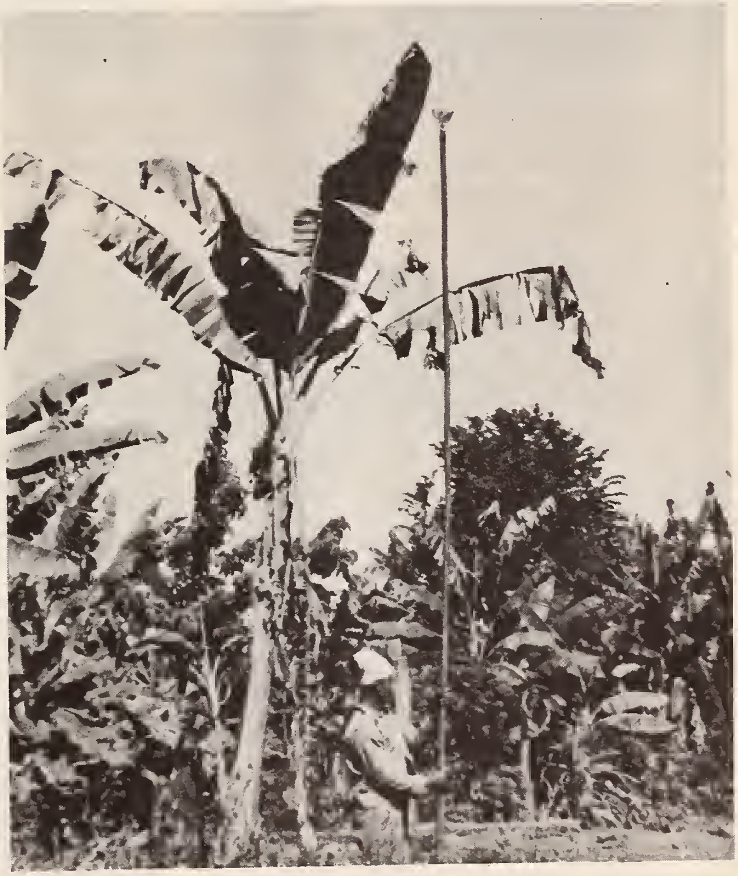


FIGURE 68.-Cutting tool used in harvesting bananas.

is required for this operation, since the trunk must not be completely severed but only enough to permit the top of the tree to fall over gently so that it can be caught by the man on the ground. If the top is allowed to crash to the ground the stem or bunch of bananas is usually damaged to such an extent as to preclude its shipment to market.

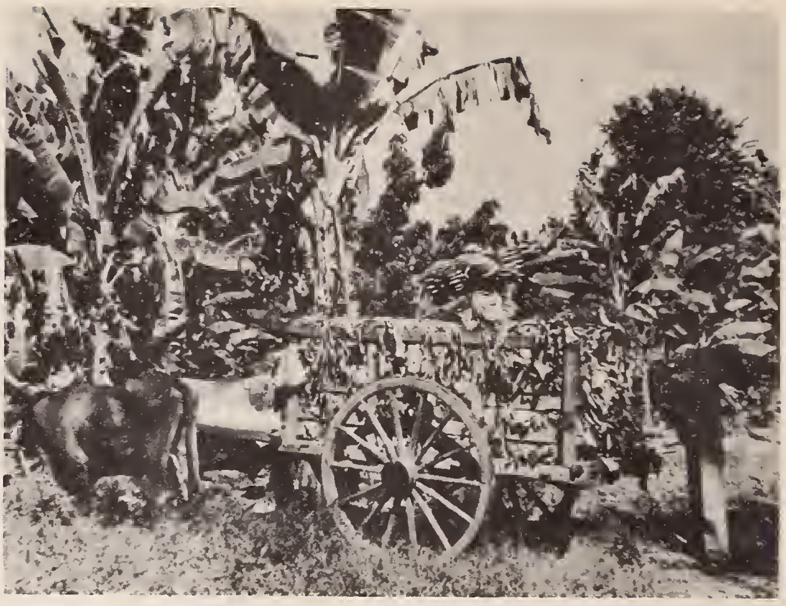


FIGURE 69.-Fruit is hauled from the field to loading point by oxcart.

The most common conveyance in use for the transportation of fruit is a cart drawn by two oxen. About 90 percent of all the fruit is hauled to the station in this manner. Those owners who have a truck for hauling purposes operate in somewhat different manner when harvesting. After the fruit has been collected in the field, the oxcarts haul it to a central location, where a stock pile is established. The truck operates between this stock pile and the railroad loading point. This method of hauling the fruit has the advantage of being a good deal faster than that of the oxcart. There is an additional operation required, however, the unloading of the carts and the loading of the truck. Trucking fruit has its drawbacks. Farmers who truck their fruit to the loading point must maintain their roads in a much better condition than those who send their fruit by oxcart. Many of the growers expressed interest in the purchase of trucks to haul their fruit, but they cannot be obtained until after the close of the war.

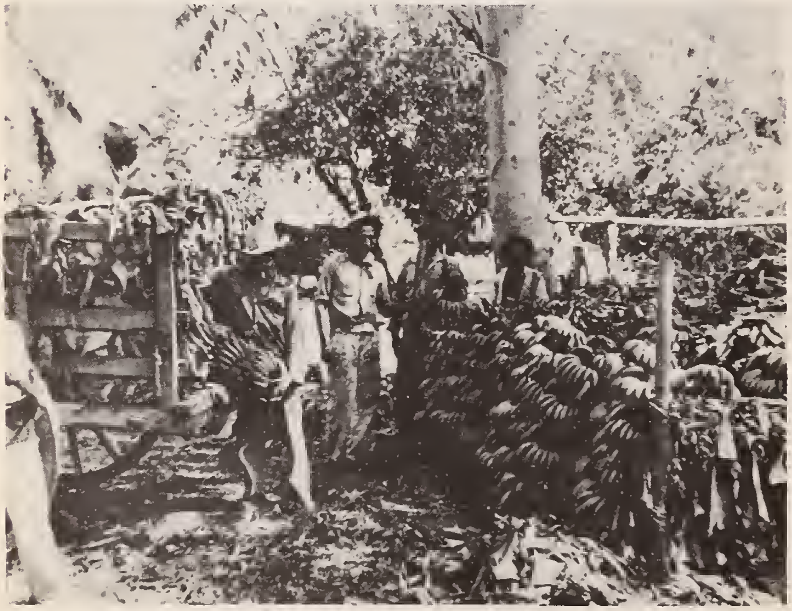


FIGURE 70.- Delivering bananas from the field to the stock pile where they are picked up by motor truck.

The upkeep and building of roads to and from loading points have called for the expenditure of considerable

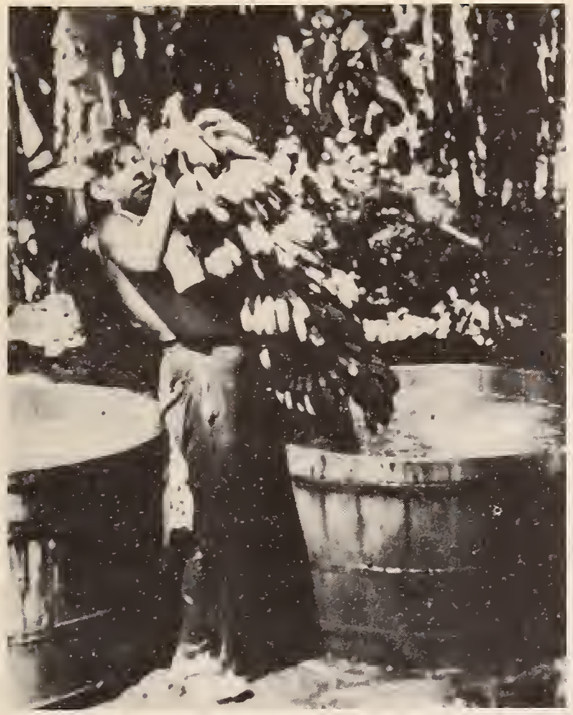


FIGURE 71.- Removing spray residue by dipping in a weak solution of acid.

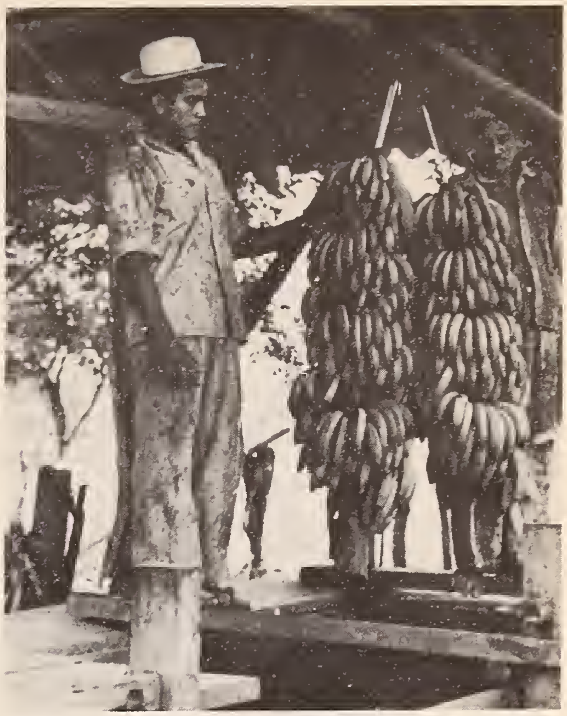


FIGURE 72.-Washing bananas after they have been dipped in acid solution.

sums of money. Conditions for transport are not bad during the dry season, but during the rainy season the roads need constant attention to keep them passable.

As mentioned previously, most of the plantings are located quite close to the railroad, probably on an average not more than 2 kilometers (1.25 miles) away. The usual charge of cart owners for hauling this distance is 1.20 pesos (about 25 cents) per trip. A load averages some 20 stems. Distances greater than 3 or 4 kilometers net the oxcart owner about 1.50 pesos (31 cents) for his trip.

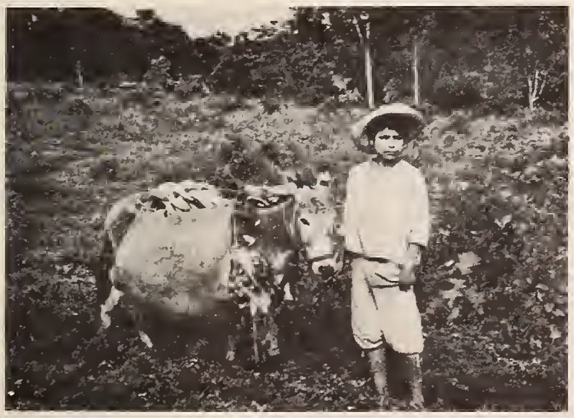


FIGURE 73.- Most of the fruit in the Córdoba area is brought to loading points on burros.

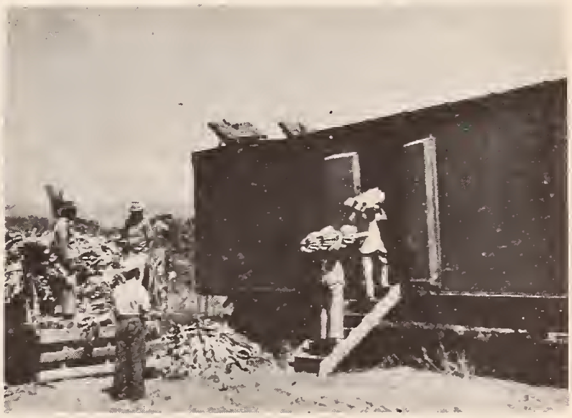


FIGURE 74.-Loading bananas into a refrigerat car in Chiapas.

When the fruit arrives at the railway loading point, it must first be dipped in a weak acid solution in order to remove the spray residue. After the chemical bath it is passed through clean water. The next step is to set the fruit aside and allow it to dry before it is stacked in the cars.

A number of the growers make no attempt to classify fruit at the loading points. Fruit is stacked in the cars regardless of the size of the stems. A few of the more discriminating producers take pains to segregate the bananas according to the stem size. For example, they will forward a car of 9's, two of 8's, and one of 7's. Nothing below this last-mentioned size is sent out.

Labor and Health Conditions

Because of the current boom in the industry and the additional working hours resulting from spraying operations, there is a shortage of labor in the banana regions. The importation of laborers from towns on the Isthmus of Tehuantepec has been necessary. Although the shortage of workers has not yet reached a critical point, if plantations expand rapidly, help will have to be brought from other districts, perhaps from the plateau section of the State. From time to time Guatemalans have crossed the border to work in the banana district. Especially is this true during the peak months of the harvest, August, September, and October. Spraying operations are the heaviest in this period, and generally movements of fruit run the largest.

Health conditions in the coastal area of Chiapas leave something to be desired. Malaria is prevalent, especially during the rainy season. It constitutes a constant menace to the general welfare of the region, but a more serious problem is a disease that causes blindness. The most heavily affected district is that of Soconusco. This disease, Ochoncercosis, is, as far as known, transmitted by a fly. Usually a cyst appears in the back of the head. If it is cut out before the optic nerve is affected, blindness can usually be prevented. Its presence in the banana region is evident, but the coffee district, located up in the coastal range, is more severely affected.

Costs of Production

Wages. The wage rate prevailing in the Chiapas banana district is 2.10 pesos (43 cents) per day. Actually the basic wage rate is 1.80 pesos daily, but workers receive an additional 30 centavos (6 cents) to cover the Sunday rest day. In other words, workers only put in 6 days each week but are paid for 7. This additional pay has resulted from the efforts of the local agricultural syndicates, which were organized in 1937 during the time of land expropriation. Up until 1940 they constituted a strong force in the agriculture of the coastal region. At the present time, however, they are breaking up. In those sections nearest Tapachula the syndicates are the weakest. As one goes northward from this town, they appear to be considerably stronger. In the vicinity of Mapastepec these organizations have the most potent voice. These groups are expected to become weaker as time goes by.

While common labor draws the above-cited wages, other workers, who perform tasks that are of a special nature, receive their pay on a piece basis. For example, a worker who cuts bananas from the trunk receives about 2 centavos (less than 0.5 cent) per bunch. A fast worker can earn about 8.00 pesos ($1.65) daily. His helpers, who carry the bunches from the fields to the roads, get 4 centavos per trip. The receiver in the central loading depot, who carries the fruit from the stock pile to the carts, makes 0.5 centavo per bunch. Likewise those who take the bananas from the cart to the refrigerator car make 0.5 centavo per bunch. The stevedore, who checks the amount of fruit that arrives and supervises the loading, makes 8.00 pesos daily. It should be pointed out that these men do this some 2 or 3 days a week only, when there are cars available for shipment. The rest of the time they perform diversified tasks on the plantations, such as cleaning or pruning.

Power. Oxen are by far the most commonly used draft animals. About 90 percent of the producers use them exclusively for all the heavy work on the plantations. Some use is made of horses, but it is not great. Horses and mules are the most common means of transportation. Contrary to the custom in many parts of Mexico, burros are not widely employed.

Generally the producers do not own all the oxen needed to perform the various tasks and must necessarily rent them from one of the workers of the community. The cost to the grower for a day's labor of a team of oxen runs about 5.00 pesos ($1.03). This sum includes the wages of the worker tending the team. The use of mechanical equipment, such as tractors, is still extremely limited. Of all the ranches visited, only four worked steadily with gasoline-powered equipment. Those growers using tractors extensively owned the equipment themselves.

Rents and land. Little land is rented for crop use in the Chiapas banana region. If a grower rents, however, the general charge is 10.00 pesos per hectare (about 83 cents per acre). The value of land varies between 60 and 150 pesos per hectare ($4.99 and $12.49 per acre), depending upon its location and the quality of the soil. In certain districts, such as Acapetahua, the purchase of good-quality land is becoming increasingly difficult. One has to go back a distance of 6 or 7 kilometers into the interior to find land to buy. Naturally, 6 or 7 kilometers (about 4 or 4.5 miles) present few troubles if trucks are used to haul the products to loading points. Since the whole industry is geared to the movement of slow-going oxen, however, an additional kilometer (0.6 mile) or two slows down the transportation scheme very noticeably.

As is true in most of the rural districts of Mexico, a small farmer has difficulty in procuring loans from the established agricultural banks. Chiapas in this respect is a case in point. As already stated, only some 30 producers in the entire State are in possession of spraying machines and chemicals. In January many of the smaller farmers expressed their interest in obtaining machinery for control purposes, but added that such was impossible unless one was well known and had a considerable acreage of land under cultivation. The Banco de Comercio Exterior lends money to the larger growers at 10 percent. But the bank also charges the borrowers 5 centavos (1 cent) on each stem of fruit it handles through its marketing agency, the Comité de Ventas. Growers who borrow through the bank are obliged to join this last-mentioned organization before any loan is made. Thus, under such an arrangement, the bank is fairly well assured of a safe return on its money.

In a nutshell, only the larger well-known producers can obtain loans. If smaller producers and ejidatarios must borrow, it is usually from a larger producer and at interest rates ranging from 15 to 20 percent.

Planting material. Bulbs or rootstock for planting purposes run from 80 to 100 pesos ($16.46 to $20.57) per 1,000, depending upon the quality of the material. The rootstock generally originates from the older mats under cultivation by the same owner. Expansion is taking place, but it is not because of newcomers to the region; the established producers are expanding their own properties. If they do not have sufficient planting material from their own lands, it is usually brought in from adjacent plantations. For short hauls to the new fields the average charge is 20.00 pesos ($4.11) per 1,000 bulbs.

Spraying equipment and chemicals. Two sizes of spraying machines are currently in use in Chiapas. The smaller of the two has a tank capacity of 150 gallons and costs 3,400 pesos (about $699) complete, including the nozzles and hose. A charge of 5,400 pesos (around $1,100) is made for the larger machine which has a capacity of 300 gallons. In January of 1943 the cost of copper sulfate per metric ton was 670 pesos ($138) and lime was selling at 60 pesos ($12). Prices for the last-mentioned articles are understood to have taken a rise in the first half of 1942. The bulk of copper sulfate is imported from the United States and arrives at Chiapas packed in 100-pound paper bags. The hydrated lime is a product of Mexico.

Taxes. While banana lands can be bought at from 80 to 150 pesos per hectare ($6.66 to $12.49 per acre), actual assessments are considerably above these figures. At times the assessed values run to 400 pesos per hectare ($33.30 per acre). According to the established tax arrangement, the average value of land should be 100 pesos a hectare ($8.32 per acre). If the established system were followed out, a producer would pay 12 percent of the value, or 12.00 pesos ($1.00 per acre) for state taxes. The federal tax would be 15 percent of the last-cited figure, or 1.80 pesos ($0.15 per acre). On this total of 13.80 pesos a state road tax would be 10 percent. This last amounts to 1.38 pesos ($0.11) making the total tax per hectare 15.18 pesos ($1.26 per acre).

Organizations.

By far the most important organization in Chiapas working with bananas is the Banco de Comercio Exterior and its subsidiary, the Comité de Ventas. The bank appoints the officials of the Comité who serve as permanent members. Each of the four growers' associations have an elected representative on the board of directors. Weekly meetings are held on Friday, at which time the various difficulties confronting the industry are discussed. The Comité has an agricultural technician who furnishes information and helps the growers in solving special problems.

The Comité handles all shipments of bananas to the border. It arranges for the cutting of the fruit and for the delivery of cars to the various station points. It also maintains a customs agent and broker at Laredo, who handles all fruit sent out of this State by the Comité.

Prior to April 1943 the Comité de Ventas monopolized all foreign shipments of fruit from Chiapas. It has been granted a concession by the Federal Government, which extended certain privileges in the way of export-duty refunds. In April a number of the small producers, remaining outside the cooperatives which worked with the bank, were organized into the Asociación Agrícola Platanera de Pequeños Productores Independientes, S. de R. L. de S. P. y C. V. The head of this group managed to obtain an export license and has also been granted the refund previously received only by the other cooperatives. In the first part of May the first shipment of fruit is understood to have been forwarded by this group. The success of this newly organized group of small producers will be shown by future developments. The belief is that it will have a difficult time competing with the well-established cooperatives.

Handling Methods.

When bananas have been delivered to railroad loading stations from the fields, they are generally sorted into stems of 9's, 8's, and 7's. Some of the more progressive growers go to great lengths to insure the delivery of good-quality fruit. The majority, however, load their cars with anything that will sell. Because of the long haul to both the foreign and domestic markets, fruit is usually cut when slightly less than three-quarters ripe. If it is cut too ripe, spoilage is unduly high.

On arrival at Mexico City the cars are inspected, and selection is made of those suitable for delivery to the border and those to be sold domestically. Those that remain in Mexico City are handled by the larger wholesale fruit dealers, who buy bananas by the car. The fruit is taken to the Merced market and placed in large open stalls to which the retailers come to buy. Sales are small in nature. Most of the retail venders buy from 10 to 20 kilos (about 22 to 44 pounds). The fruit is taken to the various city markets by one of the *gondolas* which run on the regular trolley lines or by *cargadores*. The charge for hauling a crate of bananas from the Merced market to one of the nearby markets of the city is only 10 centavos (about 2 cents). The *cargadores*, who carry produce from one point to another, do not walk at their task, but rather swing along at a fast gait that approaches a trot. Only the larger purchases by the retail fruit markets of the city are transported by truck.

After the bananas to be forwarded to Laredo are selected, the cars are attached to one of the express trains going north. An arrangement has been made with a private firm of the United States which handles the majority of the bananas arriving at Laredo not only from Chiapas and Tabasco but from Veracruz as well.

Marketing

Since bananas were among the first fruits introduced into Mexico from other lands, they have been in the daily diet for several generations. Unlike the situation in the United States, which only knows the Gros Michel and red banana, the Mexican public has become accustomed to eating and preparing many other varieties of this fruit. In the local markets one may always obtain Gros Michel, Lady Finger, Cavendish, *ciento en boca*, manzano, Manila, and

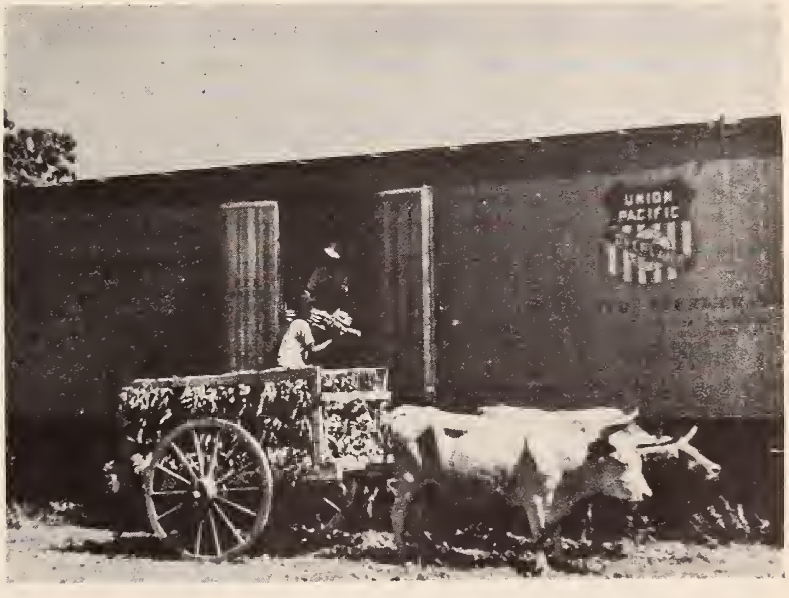


FIGURE 75.-Loading into a refrigerator car from an oxcart.

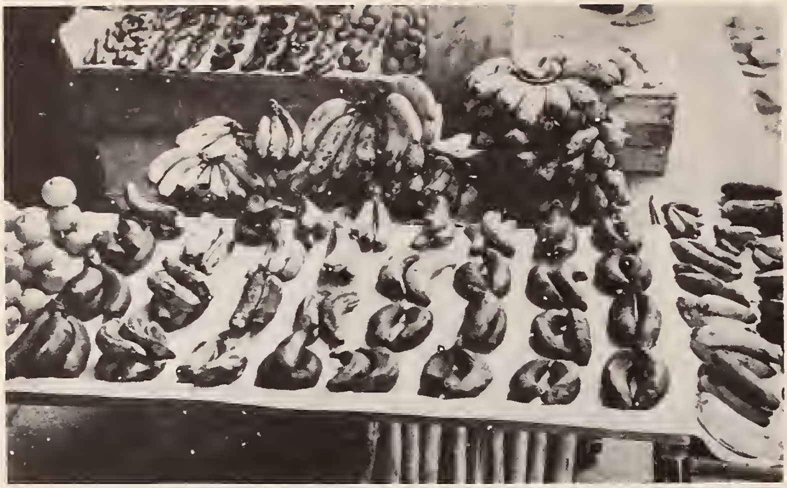


FIGURE 76.-Bananas displayed on local market.

plantains, to mention the more important varieties. The plantain, which constitutes a regular part of many rice dishes, is probably most widely consumed. This variety is generally cooked and rarely eaten in the raw state. Running a close race with plantains are Gros Michels. While it is extremely difficult to gage the popularity and consumption of the other varieties, they are believed to be consumed to about the same extent as plantains and Gros Michels.

Fluctuation in banana consumption may be attributed to price factors rather than those of supply; it is affected very little by seasonal changes. Even since the arrival of sigatoka, domestic consumption has held up fairly well, since in Mexico certain varieties are not so subject to this disease as others, and the flow of these fruits into the market has not diminished. Among them are Cavendish and plantains.

No statistics of the national consumption are available. In the tropical regions of Mexico each family has its clump of banana trees. A small portion of the fruit is sent to market, but the larger part provides an important staple for the family. This home production is not recorded by the Mexican Department of Agriculture. The Department can only approximate that amount of fruit grown in the more important producing regions. Even then there is a good deal of discrepancy between the official figures and those of the private individuals and firms connected with the trade. Bananas are, however, the top fruit in the Mexican diet. This is true not only from the point of view of popularity but also from the point of view of supply. Supplies are fairly constant the year round; they are the heaviest during the summer months when seasonal rains are present and lowest during the dry months of winter and early spring.

The public of the United States is a good deal more grade conscious than that of Mexico. Thus, when the sigatoka arrived in Mexico and the quality of fruit was greatly affected, foreign movement slumped accordingly. Of course, this decrease resulted not only from the smaller size and poorer quality of the fruit but also from the decline in production. Even after sigatoka became widespread, Mexico continued to ship fruit to the United States, but only a fraction of the former large total went forward. Attempts were made to substitute for Gros Michel bananas other varieties produced in Mexico, but the United States market was not accustomed to these. As long as there were good quantities of Central American Gros Michel available in grocery stores, they were given preference. Furthermore, other varieties do not stand transportation as well as Gros Michel. They bruise and deteriorate much more rapidly.

Costs of Shipping and Transportation

The bananas that are specifically forwarded to the domestic market generally move in ordinary freight cars. Naturally losses are greater, but shipping costs are more reasonable. Since no particular grades and standards are required, fruit is easily disposed of in the larger cities. Much greater care is exercised in the shipment of fruit to the foreign markets. Only the regular refrigerator cars from the United States are used for this purpose.

The cost of hauling an empty refrigerator car from Laredo, Texas, to Acapetahua, Chiapas, amounts to 238.50 pesos (about $49.00). Unfortunately this long trip is of little commercial benefit, because the cars usually are moved to the banana districts without cargo. The transportation of fruit in refrigerator cars costs 25 percent more than in the regular boxcars. In Mexico, in addition to an established charge for freight, the shipper must pay a nominal hauling charge. A government tax of 12.2 percent is levied on total freight charges, which are based on a minimum weight of 12.5 metric tons (13.7 short tons). Usually, however, only 10 metric tons (11 short tons) of fruit are placed in each car.

The cost of shipping bananas from Acapetahua, Chiapas, to Laredo, Texas, totals about 1,501.50 pesos or $310.00 (see table 11). A shipment from the same point to Mexico City amounts to about 582 pesos ($120.00) by refrigerator car and 419 pesos ($86.00) by boxcar (see table 12). The first sum represents the actual cost to a grower living at Acapetahua and includes not only the railroad charges, but also costs of marketing, commissions, local charges, duties, and quotas to the bank and local committee of fruit growers. The second sum does not include all the items of marketing and handling.

TABLE 11.-*Itemized costs of handling and forwarding one refrigerator car of bananas from Acapetahua, Chiapas, to Laredo, Texas*

ITEM	CHARGES	
	Pesos	*Dollars*
Freight including 12.2 percent Federal tax	831.52	171.45
Hauling charge	24.78	5.11
Mexican messenger	50.00	10.31
Mexican aforo[1]	55.60	11.46
Other charges at border	98.51	20.31
Handling across bridge	13.00	2.68
Messenger on U. S. side of border	36.38	7.50
Brokers' charges - 10 percent of sales value	312.81	64.50
Quota to "Comité de Ventas"	20.00	4.12
Federal Stamp Tax	27.49	5.67
Bank charge for handling	6.81	1.40
Checkers of fruit	10.00	2.06
Quota to local cooperative	10.00	2.06
Capital fund	4.60	.95
Total	1,501.50	309.58

[1] Mexican "aforo" is 12 percent of 3.14 pesos (about 65 cents) on each 100 kilos (about 220 pounds) of fresh bananas exported. Organized cooperatives, such as the "Comité de Ventas," are granted a refund on the regular export duties.

Banana Byproducts

Because of the difficulties in securing refrigerated cars, several producers' associations, as well as private individuals, have begun to manufacture various products from fresh bananas. The most important of these is dehydrated bananas. At the present time there is a small plant in operation at Orizaba, Veracruz, which is handling about 5 tons of fresh fruit daily. This concern is known to have a contract

TABLE 12.-*Freight charges for sending one refrigerator car from Acapetahua, Chiapas, to Mexico City*

ITEM	CHARGES	
	Pesos	*Dollars*
By refrigerator car:		
Freight (38.85 pesos per metric ton, 12.5 metric tons minimum)	485.63	100.13
Messenger	27.00	5.57
Federal Tax (12.2 percent of freight charge)	59.25	12.22
Hauling of car	10.00	2.06
Total	581.88	119.98
By boxcar	418.65	86.32

About 70 percent of the domestic fruit moves in regular boxcars. Thus, both the charges for the boxcars and refrigerator cars are cited. The price of a messenger, who travels with a refrigerated train, is not included in the forwarding cost of a regular boxcar to Mexico City.

with a large importer in New York. The product is being offered for sale by one of the large chain stores in eastern United States. Another new plant has just begun to operate near Córdoba, Veracruz. Its machinery is the best available, and considerable research was done in the United States before the plant was erected. Its potential production and ultimate market are unknown. In Villahermosa, Tabasco, another small plant is also engaged in the same manufacture, and a modern factory is planned.

A great deal of enthusiasm is now being manifested for developing dehydrating facilities for bananas in other parts of the Republic. Plans are being laid for the construction of a factory at Tapachula in Chiapas. Likewise there is discussion of a factory at Tuxpan in northern Veracruz.

This phase of the banana industry is still in its infancy, and its future is unknown, but this product is not expected to find ready sale within Mexico. The limited quantity which has recently moved to the United States is reported to have met with fair success, but undoubtedly some type of sales campaign will be needed to bring about widespread consumption. Much of the original banana flavor is lost in the dehydrating process, and the resulting product has a taste all its own.

A small factory at Tuxpan, Veracruz, is now engaged in the production of banana flour. The process used is of the most rudimentary sort, and the flour does not appear to have great sale. The dehydration plant, which will be constructed at Tapachula, is expected to include a section for the making of banana flour of a much higher quality than that produced in Tuxpan. A firm in Mexico City is manufacturing a product composed of cocoa, sugar, and bananas, which is stated to be a substitute for powdered cocoa. A small quantity of this product is being forwarded to the western section of the United States.

Another banana byproduct which is in the course of development is known as "Banibs." The process, briefly, consists of first quartering the fruit longitudinally with the skin and dehydrating it. The dried product is then finely ground and mixed with sugar for a preservative and with a stabilizer made of coconut to eliminate stickiness. The finished product is dark brown in color and is made up in the form of pellets about the size of raisins or currants. While they can be eaten out of hand, their primary purpose is for use in the baking trade.

Although processing plants for elaborating this product have not been established within the country as yet, bananas of Mexican growth have been used for conducting the necessary experiments.

In spite of all current enthusiasm for the manufacture of various products from bananas, the future of fresh fruit is believed to be better in Mexico than that of a factory-made commodity.

Foreign Trade

As previously mentioned, Mexico first began shipping bananas to foreign markets in 1906. During the first years of the industry exports were very small, averaging not more than 200,000 stems a year. Exports began to rise each year after 1906 and by 1912 the 1,000,000-mark was reached. By 1914, 2,000,000 stems were leaving Mexico yearly for the United States. The only important producing district at that time was Tabasco.

During the World War I exports slumped to 300,000 stems (1917). After the termination of hostilities and the restoration of ocean shipping Mexico once again began to send large amounts of fruit to foreign markets. By 1921 some 2,000,000 stems left the country and by 1927 exports exceeded 5,000,000 stems.

The export movement of this fruit began to expand rapidly in 1934, when some 8,000,000 stems moved from the various banana districts of Mexico. The following 5 years mark the peak of the industry. Exports reached 14,500,000 stems in 1936 and continued on that level through 1938. The arrival of sigatoka in 1937, coupled with the factor of the rapid development of the agrarian program, signaled the beginning of the collapse of this profitable agricultural industry. Shipments held up fairly well through 1939, when 13,430,000 stems were exported. The first real decrease took place in 1940, when only one-half the previous year's exports, or some 6,585,000 stems, moved to the United States. The recent low point in the export of fruit was in 1941, when only 5,165,000 stems moved from the country.

The initiation of control programs in Tabasco and Chiapas, together with the fact that Mexico is the only country in a position to forward its bananas to the United States by land, has made for a slight increase in exports since 1941.

Control programs have not been under way long enough to predict that Mexico is really in a position to compete with the fruit of the Central Americas. Undoubtedly some of the affected fruit of Veracruz and Oaxaca, currently being received, will have a hard time finding a ready market when first-quality Central American bananas are once again available On the basis of present conditions, Mexico may continue to be the top supplier of this fruit to the United States for the duration of the war. Subsequent developments depend largely upon the adoption of growing, handling, and transportation practices.

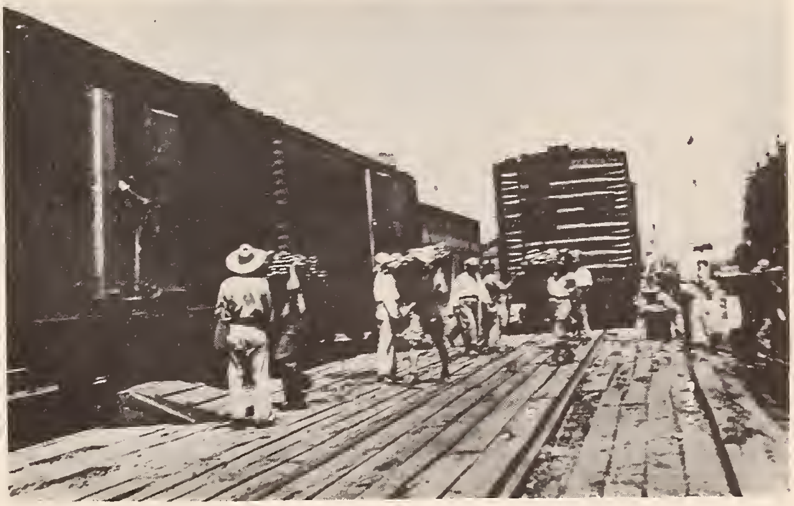


FIGURE 77.-Loading operations on the wharf at Coatzacoalcos. The fruit is transferred from the barge shown on the right to the refrigerator cars.

In the past Tabasco furnished at least 50 percent of all banana exports; today it supplies only 2 or 3 percent. Most of the export bananas now originate in Chiapas. While no definite figures are available as to the exact origin of fruit moving to the United States, the break-down by districts seems to be about as follows: Chiapas, 50 percent; southern Veracruz, 20 percent; northern Veracruz, 15 percent; Córdoba, 10 percent; Tabasco, 3 percent; and the remaining 2 percent is picked up in small lots along the Pan American Highway.

TABLE 13.-*Banana exports from Mexico, 1932-42*

YEAR	STEMS	YEAR	STEMS	YEAR	STEMS
1932	4,205,634	1936	14,529,259	1940	6,585,912
1933	5,800,499	1937	14,752,424	1941	5,165,483
1934	8,005,751	1938	14,345,302		
1935	11,065,330	1939	13,428,699	1942	5,856,544

Compiled from the records of the Dirección General de Estadística.

In 1927 Mexico supplied about 8 percent of the bananas imported into the United States, which totaled 61,000,000 stems. This percentage increased yearly, and by 1936 Mexico accounted for some 26 percent or one-fourth of all the bananas consumed in the United States. From 1936 to 1939 this position was maintained. By 1940 the percentage of imports had dropped to 12 percent. Unfortunately data relative to imports for 1941 are not available, but the belief is that Mexico contributed a smaller percentage than in 1940. By 1942, however, this was probably changed to a much higher percentage. This resulted from Mexico's geographic proximity to the United States and the fact that the fruit could be moved by land. Central American republics, with heavier production, were curtailed in their exports because of the shipping shortage.

TABLE 14.-*Imports of bananas into the United States from Mexico and other countries, 1927-40*

YEAR	MEXICO	OTHERS	TOTAL	PERCENTAGE OF IMPORTS FROM MEXICO
	Stems	*Stems*	*Stems*	*Percent*
1927	5,272,859	55,736,566	61,009,425	8.6
1928	5,526,200	58,781,456	64,307,656	8.6
1929	5,700,484	59,433,622	65,134,106	8.8
1930	6,505,320	56,225,507	62,730,827	10.4
1931	5,164,404	50,689,226	55,853,630	9.2
1932	4,548,991	44,908,123	49,457,114	9.2
1933	6,590,908	33,022,498	39,613,406	16.6
1934	8,585,943	39,093,277	47,679,220	18.0
1935	12,346,616	42,672,523	55,019,139	22.4
1936	15,554,606	42,747,769	58,302,375	26.7
1937	16,765,514	49,821,278	66,586,792	25.2
1938	15,497,429	43,745,448	59,242,877	26.2
1939	13,913,486	43,214,524	57,128,010	24.4
1940	6,613,890	45,722,270	52,336,160	12.6

Foreign Commerce and Navigation of the United States.

Export Duties and Taxes

When the banana industry began to expand rapidly in the early 1930's the export tax was 2 centavos (less than half a cent) per bunch regardless of the weight and size. Subsequently the price was reduced to 1 centavo per bunch and remained at this level until 1935, when the Mexican Government imposed a tax of 30.00 pesos ($8.33) per ton. The motive behind this action was to bring all the producers together in cooperatives which would be granted a subsidy of 30.00 pesos per ton on all fruit exported, thus offsetting the government tax. It will be recalled that the years 1934 and 1935 marked the beginning of the agrarian program of the Cárdenas regime.

This ton tax was applied to fruit moving by land as well as by water, but the manner of determining the weight of a ton of bananas differed. Taxes and duties were assessed on the basis of weight of fruit loaded on freight cars for that amount of fruit which passed through land ports. For shipment on ocean-going vessels each stem was assumed to weigh 22 kilos (about 48 pounds), thus, if there were 10,000 stems for shipment the weight according to this scheme amounted to 220 metric tons (242.5 short tons).

Prior to the outbreak of sigatoka, the average weight of exportable stems ran close to 22 kilos. The weight of stems leaving Mexico from 1939 onward, however, because of the inroads of this disease, averaged some 17 kilos only and in many cases ran under this weight. Taxes, notwithstanding, were still collected on the basis of a 22-kilo stem.

Even though the 30-peso export tax was nullified in the form of a subsidy, bananas have not left the country without charge. There are other taxes collected which are known as *adicionales*. These have amounted to about 1.80 pesos (37 cents) per ton. Part of this sum goes for Federal revenue stamps and the remainder is paid in cash.

When the Mexican Government established the 30-peso export tax in 1935, the opinion was that no producer could afford to market his fruit outside the cooperatives, and that the cooperative concept then being developed would become the basis of Mexican agriculture. Certain producers, however, found it more convenient to export fruit independently than through one of the cooperatives. Because the so-called cooperatives were newly authorized, they were often overburdened with red tape, and the farmer was not sure whether or not his fruit would be delivered to market. The fact is that those producers who sent their fruit to market on their own initiative and had to pay the municipal, state, and federal taxes often netted a better financial return for their bananas than those producers who moved directly through cooperatives. On January 22, 1943, a Presidential decree terminated the possibility of any single individual exporting fruit. By this decree a new quota system, based on the per-100-kilo valuation of bananas was established. On fruit of the best quality, the export duty would amount to 5,700 pesos ($1,172) per car of 10 tons. Members of cooperatives recognized by the Government are, however, granted a subsidy to the extent of the fixed charges. Under these conditions an individual could not ship to the United States and expect to make a profit.

In the preamble to the decree a number of sections are devoted to explaining why this particular change was being made. It stated that since Mexico had to expend considerable sums of money to control sigatoka, only the best quality fruit should be exported. In order to compete with other countries, a control was needed for the purpose of determining which cooperatives were in a position to forward the best marketable fruit. By a second decree published on February 2, 1943, in the "Diario Oficial," an official government publication, an alteration was made of the decree of January 22. It was stated that the subsidy granted to recognized cooperatives would be to the extent of 98 percent of the export duty.

State Legislation

In addition to the Federal export taxes, each of the banana-producing States levies other charges on production and marketing. For example, in Chiapas there is a production tax of some 10 centavos per stem. In addition, 4 percent of this amount is charged when the fruit is sent to market. In Oaxaca production charges are

5 pesos (about $1.00) per metric ton, and there are no additional taxes for marketing. Growers in Tabasco have to pay a production tax of 11 centavos and in addition 5 percent of this tax on the fruit sent to market. The State of Veracruz does not have a production tax, but levies a charge of 1 peso per ton for marketing. In each of the states mentioned there are municipal charges based on production and marketing. These are very diversified, averaging about 10 percent of the total state charges. In Tabasco there is an additional 25 percent levied by the State on the production and marketing taxes. Usually the Federal Government levies a charge of 15 percent on total state charges.

FIGURE 78.- Mr. Frank Peters, an American, started the first plantings of the small Cayenne pineapple at Loma Bonita in 1906. Though past 70 he still actively engages in the production of this fruit.

PINEAPPLES

Development of the Industry

When the Spaniards first arrived in Mexico pineapples were being cultivated by the natives. This fact is attested to by the early chroniclers who accompanied the conquerors. The fruit was called by the Aztec Indian name, "matzatli." A small acidulous fruit of the same description, now known as *piña corriente*, is still grown in many parts of the Republic. The corriente supplies the flavor of rural *refrescos* and that of a popular native drink called *tepache*. Many of the pineapples grown today were introduced during the colonial period of Mexican history (1521-1800). No exact record appears to exist of the date of introduction of each of the eight varieties now produced in Mexico. Because of the manner in which interchange of products was fostered under the Spanish colonial system, several varieties undoubtedly arrived in Mexico prior to 1600.

While pineapples have been produced in Mexico since preconquest times, the modern industry dates from the turn of the twentieth century. By 1900 pineapples were growing on a small scale in many parts of the country, probably in all the States in which they are grown today. Commercially, however, the crop was just beginning.

In 1906, shortly after the opening of the Pan-American Railroad from Veracruz to Guatemala, an American by the name of Frank Peters introduced a thousand plants of the Smooth Cayenne variety into Loma Bonita, one of the new stations along the line. These new plantings marked the opening of the largest pineapple-growing section in Mexico. Likewise this date signified the start of the commercial pineapple industry. Since that time the Loma Bonita district has produced more than half the pineapples grown in the Republic.

The newly set out plants did very well. Acreage was expanded in 1907 and continued to increase until 1914, when 500,000 plants were under cultivation on about 35 hectares (86 acres) of land. Although some fruit had previously been shipped to the Mexico City market, this was the first year that promised marketing on a large scale. Very little of the crop was removed from the fields, however, because of the Mexican Revolution.

The Revolution began in 1910, but it was not severely felt in the Loma Bonita section until 1913. In that year the majority of the American colony, which consisted of about 90 persons, abandoned their lands and departed for the United States. By 1914 civil strife had become general in southern Veracruz. Railway service was irregular, and such transportation facilities as still remained were taken over for army use. To market such a crop as pineapples, the harvesting of which is heavy for 3 months, was impossible under the conditions prevailing at that time.

From 1914 to 1921 the growing of pineapples in this section was practically abandoned. It was dangerous to live any distance outside a settlement, and farmers did not actively engage in any new development until the fall of 1920. By 1925 some 5,000 metric tons (5,512 short tons) were being produced yearly at Loma Bonita, compared with the total Mexican production of 18,400 metric tons (20,282 short tons).

From 1920 to 1925 the section near Isla, Veracruz, some 30 miles to the south of Loma Bonita, began to develop. Today Isla produces about the same amount of pineapples as does Loma Bonita. But in the statistical break-down of the country by producing areas Veracruz and Oaxaca are included in one category. By 1928 production in the whole area had reached 8,000 metric tons (8,800 short tons), and small shipments of pineapples were going to the United States. They were, however, only token in nature.

TABLE 15. *Acreage and production of pineapples in Mexico by principal States, 1937-41*

STATE	ACREAGE					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
San Luis Potosí	116	81	168	521	504	907	696	908	2,701	2,636
Tabasco	178	163	133	111	91	1,830	1,631	1,451	1,065	761
Veracruz . . .	875	1,057	944	1,475	1,915	8,145	7,677	7,730	13,535	14,449
Yucatán	101	114	131	188	319	1,210	990	1,070	1,005	2,380
Nayarit	101	153	128	197	573	711	1,180	1,014	1,543	5,093
Sinaloa	131	99	149	150	252	1,185	882	1,323	1,009	1,124
Colima	146	139	84	81	153	1,325	1,348	759	390	1,354
Chiapas	250	413	354	274	232	2,128	2,296	2,179	1,909	1,473
Guerrero . . .	267	364	277	203	235	2,340	2,917	1,680	1,653	1,297
Oaxaca	2,048	1,584	1,690	1,730	2,143	19,286	15,494	13,952	15,376	21,821
Hidalgo	277	175	284	203	91	1,820	966	772	1,404	811
Jalisco	121	104	76	79	138	1,374	1,033	937	948	702
Puebla	203	131	107	112	104	2,916	1,714	1,042	914	981
Others	175	125	182	164	189	1,861	1,294	1,214	887	818
Total	4,989	4,702	4,707	5,488	6,939	47,038	40,118	36,031	44,339	55,700

Compiled from official sources.

Areas of Production

The range of pineapples in Mexico runs all the way from the State of Sonora, which borders on Arizona, to the Guatemalan frontier. The plant is distributed in 17 of the 28 Mexican States. As generally occurs in commercial production, a few areas are more favored as to climatic and soil conditions than others. In these the largest plantings are to be found. From the standpoint of production and sale, the Loma Bonita area is by far the most important. As already pointed out, it lies in southern Veracruz and northeastern Oaxaca. Over half the 1941 crop of 50,500 metric tons (55,700 short tons) was grown there. Its importance is considerably greater, however, in relation to marketing, for it is the point of origin for about 85 percent of all exports.

The Loma Bonita area is about 60 miles inland from the Gulf of Mexico. At its lowest point it is 100 feet above sea level, and the highest piece of cultivated land to the west of the railroad is about 200 feet. This region begins about 115 miles south of the important seaport of Veracruz and follows the Pan-American Railway for some 50 miles more. By railway mileage it is about 1,125 miles from Laredo, Texas, where most of the export fruit crosses the border.

In the eastern half of Mexico there are several other producing areas worthy of mention. About 500 miles north of Loma Bonita in the Huasteca section of the States of Hidalgo and San Luis Potosí is located the second most important growing region in Mexico. Although production in this area, 3,000 metric tons (3,300 short tons), falls far short of the heavy harvest in Veracruz, it is nonetheless important to the surrounding towns. Sarabia and Mogoñe, to the south on the Isthmus of Tehuantepec, are becoming increasingly well known for pineapple production.

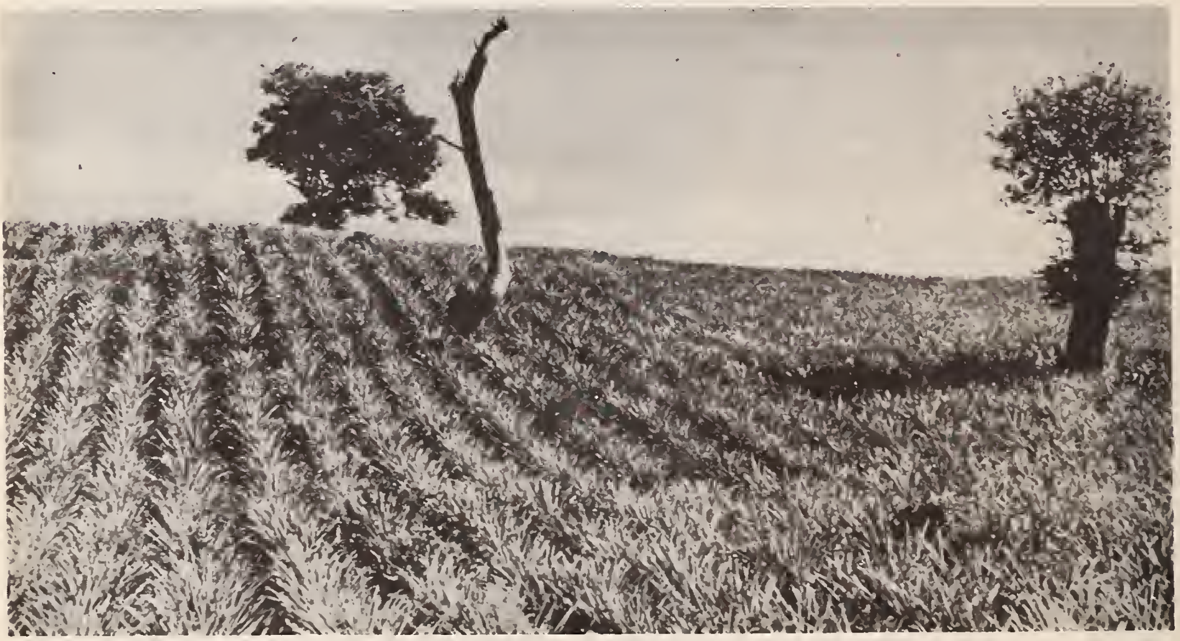


FIGURE 79.-Most of the pineapples in the Loma Bonita region are planted on hillsides. Better yields are obtained on the rolling lands than on the flatter lands to the Gulf side of Loma Bonita, also better drainage is insured.

In the States of Nayarit and Guerrero, on the Pacific coast, are the only production zones worthy of note in the western half of Mexico. Pineapples are cultivated on the coastal plain in Guerrero, and in Nayarit the industry is situated in the inland valleys near Tepic. A small producing region is located in the central portion of Oaxaca.

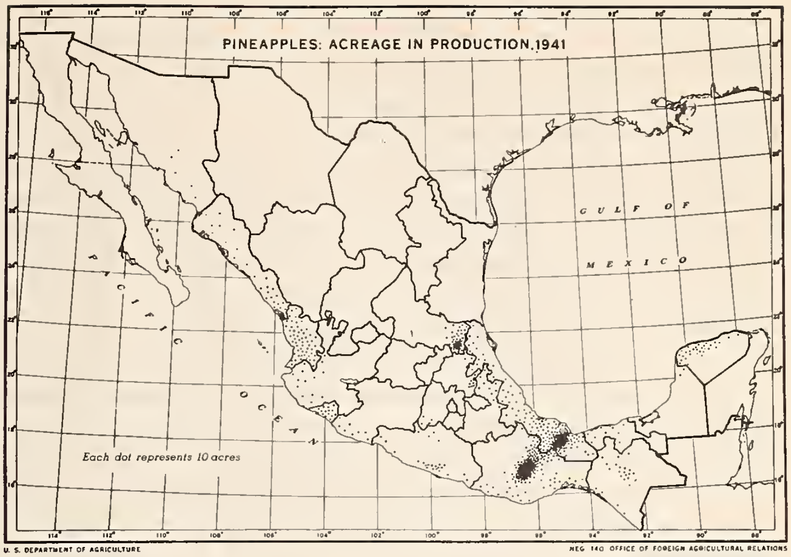

PINEAPPLES: ACREAGE IN PRODUCTION,1941
GULF OF
MEXICO
Each dot represents 10 acres
U. S. DEPARTMENT OF AGRICULTURE
NEG 140 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 80.-Distribution of pineapples in Mexico.

Production

During 8 years following 1925, the production of pineapples in Mexico remained fairly static, averaging about 18,000 metric tons (19,800 short tons) per year. In 1935 the first sharp increase occurred. Production rose again in 1936, and national figures reached 43,000 tons, the highest on record to that date. This rapid expansion can be attributed to increased demand in foreign countries, especially in the United States. For example, beginning in 1933 exports to the United States moved from 570 metric tons (628 short tons) to some 2,536 tons (2,795) in the space of 2 years. Producers thus saw an opportunity to increase production by extending market outlets. While foreign sales increased steadily after 1933, at the rate of some 1,000 metric tons (1,100 short tons) per year, production expanded at a still faster pace. Consequently a large part of the crops of 1936 and 1937 rotted in the fields. By the end of the latter year, farmers realized that neither the domestic nor the foreign market could absorb their fruit at the rate at which it was being produced. A definite reduction, 6,000 tons (6,600 short tons), therefore, took place in 1938, and in 1939 production declined to 32,000 metric tons (35,000 short tons).

With the outbreak of war, foreign markets again showed increasing promise. The United States trade was already acquainted with Mexican pineapples, and this fruit could be procured via land instead of the sea voyage required for pineapples from all other foreign sources. Mexico's unique position in this respect, along with other factors, gave new hope to its farmers.

In spite of a better outlet, losses of fruit still ran high at the producing center, and, according to local estimates, about 20 percent of the 1941 crop went to waste. In 1942 the loss was even greater; partially because of overproduction, but also because of an inadequate and overburdened rail system, about 40 percent of the crop from Loma Bonita was lost. The total Mexican production has been revised downward to 44,000 short tons, but this is not the final figure. The 1943 crop is expected to be little, if any, larger. A good deal of trouble is still envisaged in securing sufficient railway transportation, even with the new repairs being effected on the Pan-American line.

The Loma Bonita district, which receives more cars than any other, has found a new avenue for transporting its fruit to market. One of the small tributaries of the Papaloapam River, the Pase de las Yeguas, runs within a few miles of Loma Bonita. Growers are hauling their fruit to this stream, loading it in launches, and sending it down the Papaloápam to the port of Alvarado. Here the pineapples are transferred to boxcars of the narrow-gage railway that runs northward to Veracruz and then to Mexico City. If the fruit is not disposed of in Mexico City, it is transshipped to El Paso or to Laredo, Texas. Although this roundabout way of shipping makes for increased handling and higher costs, the demand for pineapples in the United States and the good prices now being received help to offset some of the previous losses sustained by the pineapple growers of Loma Bonita.

In the Chiapas and Tabasco districts, most of the refrigerator cars available are being used for transporting bananas. Pineapples have to be moved, therefore, by regular boxcars. Since these are none too plentiful, some growers have resorted to gondolas covered with palm leaves in order to move their fruit to market.

At Isla, the growers are altogether dependent on the railroad, and cars are not regularly available. Losses are expected to be high there and on the Isthmus of Tehuantepec.

Farms and Producers

As was true with other crops in Mexico prior to expropriation and the break-up of haciendas, the production of pineapples was limited to a few producers who cultivated large individual tracts. For example, before 1937 the bulk of production at Loma Bonita resulted from the efforts of some 12 independent growers. Now the situation has greatly changed, and approximately one-half the total production is by *ejidatarios;* the remaining 50 percent, by large producers. It should be pointed out that the amount of land worked by a single individual in the Loma Bonita section, where pineapples are the number-one industry, is a good deal larger than in other parts of Mexico. In other producing areas, the industry is carried on in much smaller units, and landholdings or land rented for the cultivation of this crop are consequently much smaller.

The number of hectares cultivated by private producers varies considerably. It runs from 150,000 plants covering 10 hectares (about 25 acres) of land to 500,000 plants covering 35 hectares (86 acres). The average number of plants cultivated by the larger growers amounts to some 250,000, which means 16 hectares (about 40 acres) cultivated.

At Isla, south of Loma Bonita, the number of plants under cultivation by a single owner averages slightly higher, about 300,000. No ejidatarios, or very small producers are found. Large independent producers are the rule. Thus, the private producer grows a far greater percentage of the crop at Isla than at Loma Bonita.

The average size of holdings, or land rented, in the Loma Bonita district runs some 200 hectares (494 acres). Usually only one-fifth or one-sixth of this amount is devoted to pineapples. Other crops, such as corn, beans, and chilies, are raised. Pineapples are rarely planted twice in succession in the same field. Generally, 5 years elapse before the same land is used again for fruit.

One should note that more than 80 percent of the larger growers rent their land. The effect of the agrarian program has been acute in this section for more than a decade, and growers appear to prefer to rent land instead of buying it outright. Farmers generally prefer to grow crops that do not require a growing period of 4 or 5 years. This feeling of uncertainty is diminishing somewhat, although it is still apparent all through the pineapple region.

Pineapples are not cultivated intensively. The farms do not border one on the other but are scattered. In spite of the fact that pineapples have been produced for almost 40 years, only a small portion of good land has been utilized. One of the chief factors limiting the expansion of this industry has been the difficulty of transporting the fruit from the field to the railway station. For this reason the farms are generally situated parallel to the railway line. Probably the longest haul made does not add up to more than 5 miles, beyond which point little cultivation has taken place.

In times past the area outside this zone was used to graze cattle. This industry has contracted, however, during recent years.

The ripe fruit is transported to rail sidings by oxcart. This type of transportation is geared to slow movement, but only a few of the more progressive growers employ trucks. Side roads are merely ruts through the brush, and disintegration of mechanical conveyances is rapid. It was pointed out, however, that with the increasing demand for fruit and the desire to get it to market faster more growers had planned to invest in trucks, but the war has temporarily precluded purchase of such equipment.

During the past 6 years the small farmer, ejidatario, has begun to grow considerable quantities of pineapples. The amount of land worked is naturally on a much smaller scale than that of the large growers. It runs from 1 to 4 hectares (2 to 9 acres), 2 being the average. On this amount of land they may cultivate up to 40,000 plants. Subsistence crops, such as corn and beans, take precedence, after which come the cash crops, usually chili peppers and pineapples.

During the development period cash returns to the ejidatarios from pineapples have been poor. In Loma Bonita alone there are more than 200 agrarian producers. They have had no organization and must sell to one of the larger unions or commission agents at a price under that paid to larger growers, but an attempt is now being made to organize a cooperative. This problem will be discussed at greater length in the marketing section of this report.

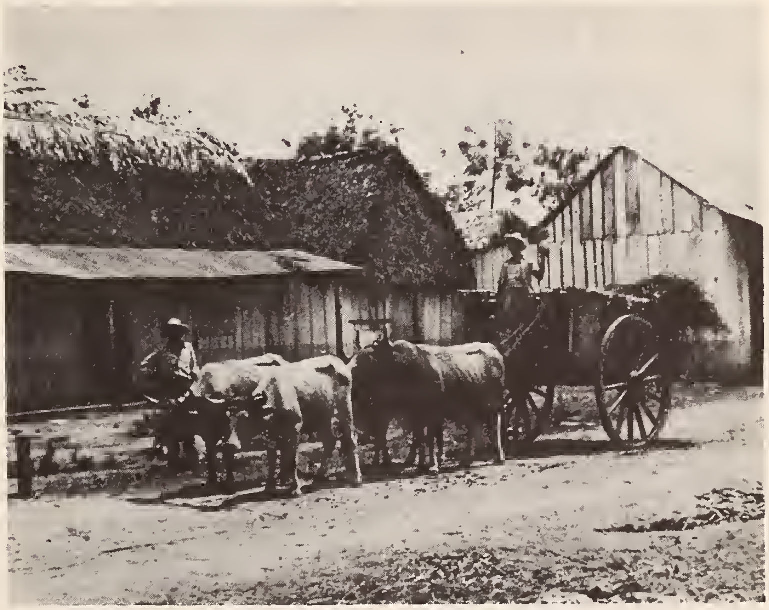


FIGURE 81.-A team of oxen bringing in pineapples from the field. When the carts have to cross swampy places, four oxen are employed instead of two.

Climate

The Loma Bonita region has about 8 months of hot weather annually. Average temperatures during the

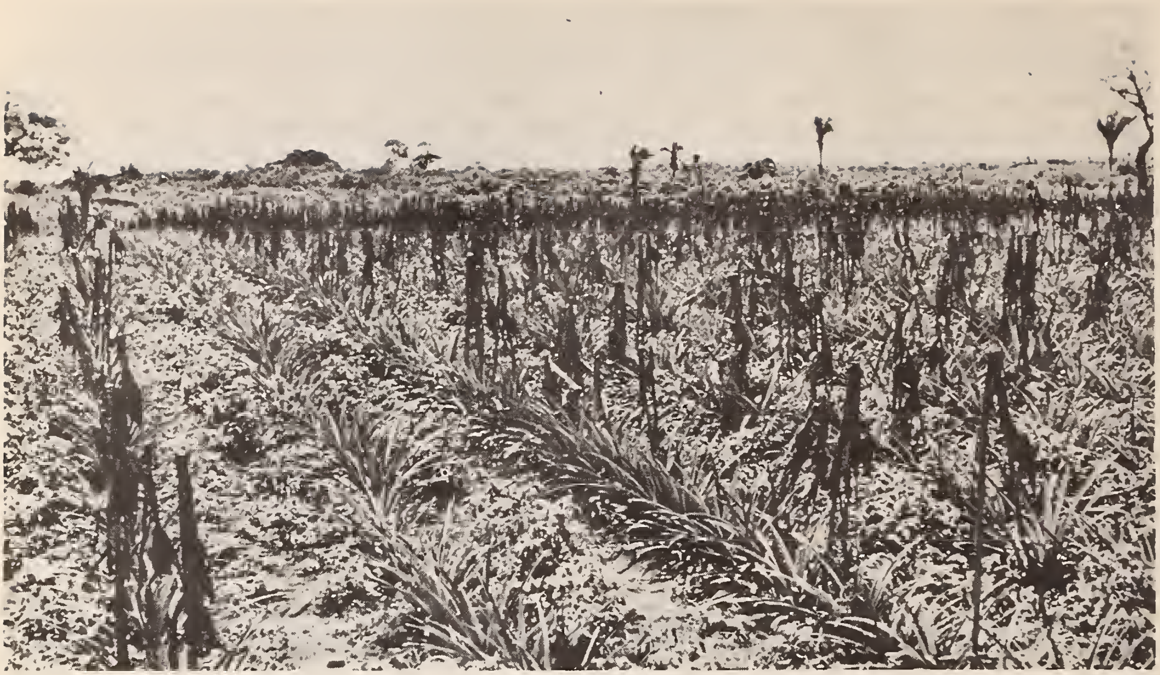


FIGURE 82.-Intercrops of corn, chili, and pineapples growing in the same field at Loma Bonita.

cooler months average about 72° F. at midday; during the months of May and June temperatures of 90° F. and thereabouts are usual. As is true in all the territory on the Gulf coast south from the Port of Veracruz, humidity is high. The rainy season is not so pronounced and definite as in other parts of Mexico. Heavy rainfall occurs during the months of May to September. No detailed records are available, but precipitation is believed to average some 70 inches per year. Frost has never been recorded. When there were a number of Americans living at Loma Bonita, an amateur form of weather recording was followed, and a record low of 56° F. was noted during 1911.

Soils

The soils of the Loma Bonita region are alluvial in origin, having a high sand content. To the west and above the town is a country characterized by gently rolling hills with intermittent level spaces. In these higher lands the surface soil is made up of 1.5 feet of black sandy loam, below which is found some 5 to 8 feet of fine sand. Under the second stratum is a clay base. Because of the physical make-up of the soil, moisture is conserved during the dry months. At the same time the high sand content insures proper drainage which is so necessary during the rainy season. Two or 3 hours after a heavy rain the ground has absorbed most of the water.

In this region the soil has received hard use, but in spite of this fact good yields of pineapples, chili peppers, and corn are still obtained. The sight of all three growing in the same field is not rare - good evidence of the fertility of the soil.

No signs of erosion are apparent in spite of the common practice of burning the field bare following harvest. In a few weeks a new growth of weeds and brush appears.

Near Isla the countryside consists of tropical savannas appearing as practically level plain. Here the soils are very sandy and in only a few places is there much black loam in the surface layer.

Varieties

By far the most prevalent variety of pineapple grown in Mexico is the Smooth Cayenne. This variety is exclusively cultivated at Loma Bonita. Likewise it is in heavy production at Isla, where some acreage is also devoted to Sugar Loaf. On the Isthmus of Tehuantepec, the Spanish and Smooth Cayenne varieties are grown. After the Guatemalan railway was completed, the Smooth Cayenne followed this natural avenue south from Loma Bonita. The railroad helps to explain why this variety is found in such volume in the whole Isthmus region.

In the Huasteca section of San Luis Potosí and Hidalgo the Esmeralda is reported to be the dominant variety. The last-mentioned is also grown in quantity near Tampico in northern Veracruz.

In most sections the small *piña corriente* is found growing on a limited scale. Only small quantities of this fruit, however, ever reach the commercial market, and none are exported.

Governmental sources state that the following eight varieties are produced in Mexico: Smooth Cayenne, White Mexican Guatemala, Esmeralda, Enville, Red Spanish, Prince Albert, Reina, and Corriente. In connection with the above-named varieties there exists a state of confusion. Wholesalers in Mexico City state that they have received Esmeralda pineapples from Loma Bonita, but, as far as can be determined by the writers, no plants of this variety exist in this section.

Many additional varieties undoubtedly exist, some of which have been lost sight of or remain unrecorded. According to trade sources, the Sugar Loaf is an important variety and is imported into the United States by that name. Piña de Cahuipa is another variety said to be popular in Mexico; it is largely cultivated in the State of Jalisco. Some claim that not a trace of acid can be discovered in this fruit.

Cultural Practices

Because of the heavy lush native vegetation that characterizes the Loma Bonita section, a cleaning process, with axes and machetes, always marks the first step in the preparation of land planting. Open grassy fields are generally not used because of poorer soil.

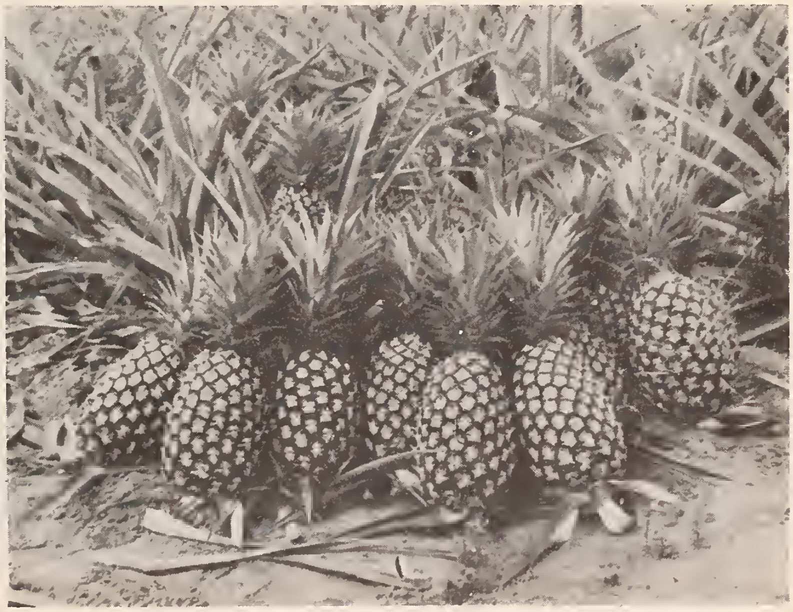


FIGURE 83.-Typical specimens produced in the Isla district.

If virgin land is to be planted, the cleaning is naturally more difficult. One should note, however, that because of the rapid growth of weeds, shrubs, and trees in the space of 4 or 5 years, during which time previously cultivated land is allowed to rest, this land is in virtually the same state as land not previously planted. In fact, at times, to distinguish between the two is difficult. The growth of the underbrush in this region is unbelievably rapid.

After the underbrush is cut away with a machete, the larger trees are felled. Then the field is burned off. The remaining logs are removed, and stumps that will interfere with cultivation are grubbed out, after which the field is plowed. Usually one plowing is sufficient, because the soil is so light that it breaks up easily. When native growth has been particularly heavy, cross-plowing is done. The field is then disked, and it is ready for planting.

The draft animal of this region is the ox, and all the farm work is performed by this animal. Burros and mules are rarely used. Horses provide the chief means of transportation for those who can afford to buy them. At one time, in the late thirties, seven tractors were given to growers to facilitate and aid in planting preparations. After a few years of misuse and neglect, however, they were relegated to the junk pile, and the use of oxen continues heavier than ever.

Propagation and planting. The pineapple is propagated by crowns, slips, suckers, and rattoons. The crown is the top or leafy part of the fruit; slips are small plants which form at the base of the fruit; suckers are shoots which develop about halfway

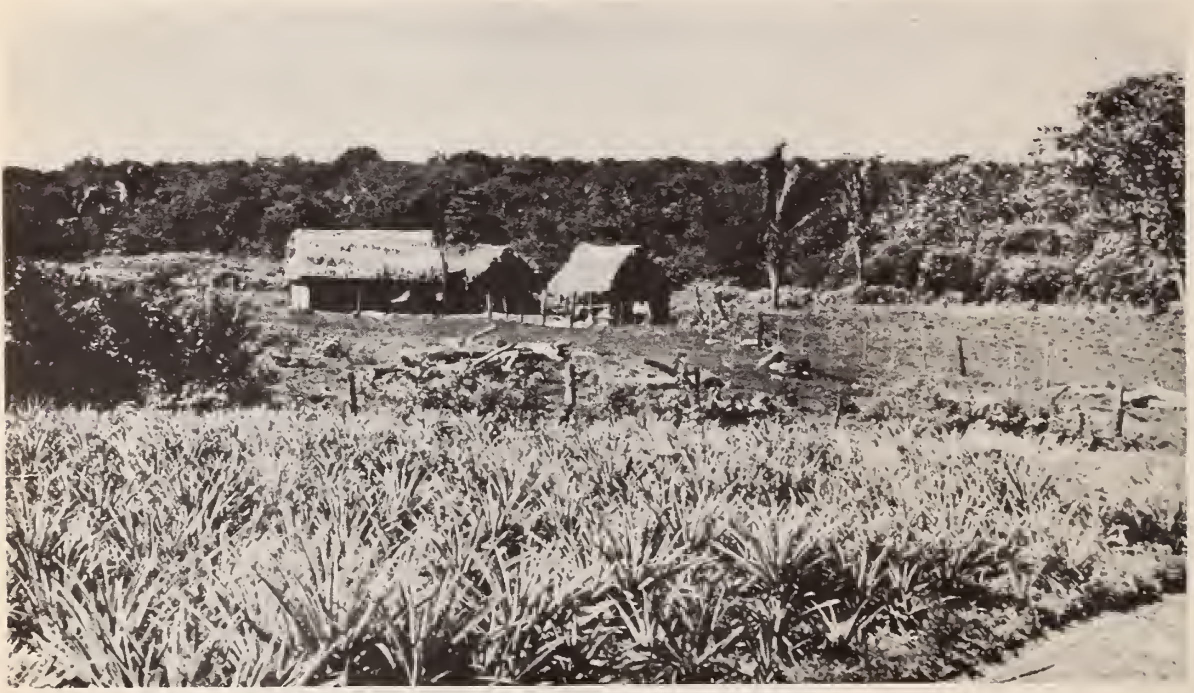


FIGURE 84.-The small huts with thatched roofs are typical dwelling places for the farmers of this region. The background has never been cleared or used for planting purposes.

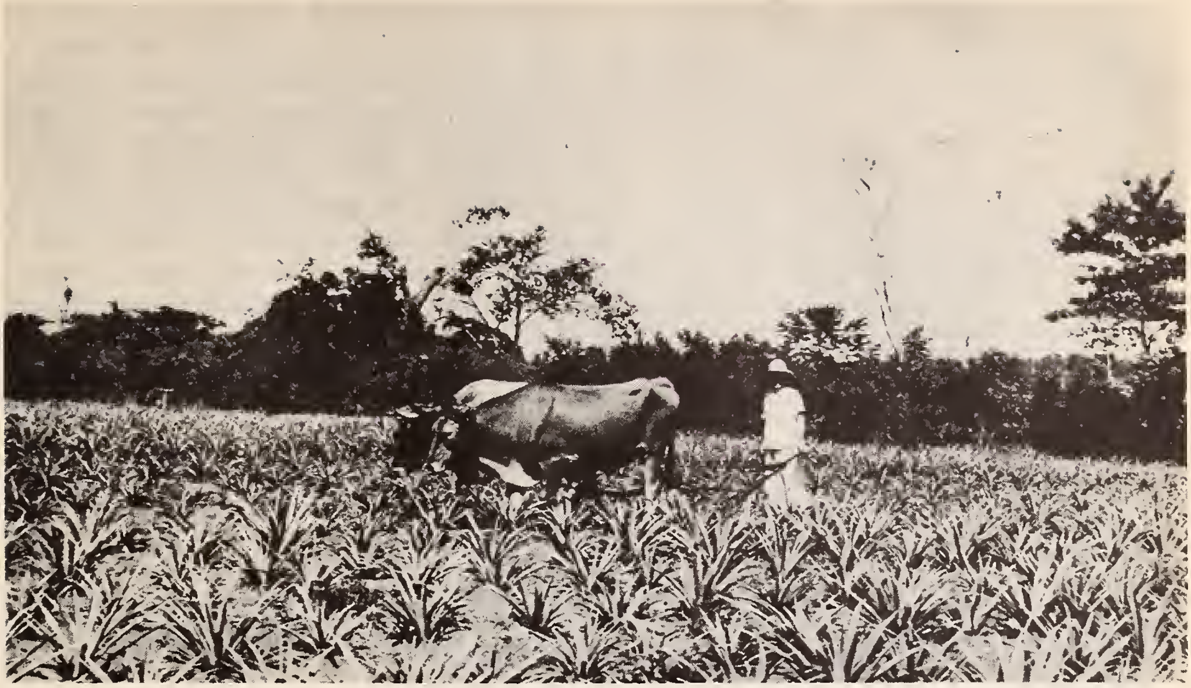


FIGURE 85.--Cultivation of pineapple plants 6 months old. Oxen are used for all draft work in the Loma Bonita section.

up the stem. Shoots that develop below the surface of the soil are known as ground suckers or rattoons. These leafy shoots, when planted with their stems extending several inches deep, develop roots that spring from buds, which form in the axils of the leaf.

Crowns are not planted extensively because they generally remain on the fruit when marketed. Good strong suckers are usually employed for planting out, since slips require a year longer to mature a crop. In establishing new plantings, suckers are used almost entirely. Generally, however, only the more progressive farmers use suckers. Indiscriminate planters use both crowns and ground suckers.

Since 1906, when the Smooth Cayenne variety was introduced at Loma Bonita, suckers from the original stock have been planted yearly, with no attempt to improve the strain through progeny selection. Old timers state that the planting material has degenerated, and yields are now somewhat lower. This is borne out by statistical data published by the Mexican Department of Agriculture, although the production of pineapples has increased. While the average yield for the Republic is 18 metric tons per hectare (8 short tons per acre), at Loma Bonita, it runs practically double that, or 30 metric tons (13 short tons per acre). Growing conditions are good at this latter place, and the great supply of fertile land still readily available for planting has helped to offset in part the degeneration of stock.

Planting material per hectare costs about 150.00 pesos ($12.50 per acre). On the average 17,000 plants are set out per hectare. Usually the fields are laid out in rows 4 feet apart, and the suckers are planted every 16 inches in the row. They are generally set 4 inches deep in the soil. More progressive growers run rows 4.5 feet apart and allow 18 inches between each sucker. Under this latter planting scheme only

15,000 suckers are planted per hectare, but yields averaged just as high as those of fields planted with 17,000 or more plants. After the plants grow larger and the rows begin filling in, the wider rows present a much easier problem of cultivation. Farmers who use the wider rows explain that on the average their fruit is larger and more uniform in size than that coming from fields following the conventional mode of planting.

All suckers are planted in the fields by hand. No mechanical planters are as yet in use. The common practice is to jab a hole in the ground with a stick, insert the sucker in the hole, and pack the earth tightly around it with the foot.

Pineapple suckers are hardy and withstand a good deal of punishment before dying. At times the practice is to place newly cut suckers in the sun for 2 or 3 weeks before planting. The explanation given for this procedure is that the new plants will toughen up in the sun and become more resistant to disease. An indication of their vitality is shown by piles of rejected suckers that have rooted and sent out new shoots after lying out of the ground for more than a month.

Planting begins as the harvest of pineapples ends. Over 80 percent of the suckers are set out during July and August, with the heaviest planting in the latter month. A few of the farmers continue to plant as late as November.

During the first year of growth, intercrops are planted between the rows of pineapples. Chili peppers constitute the usual crop. The varieties produced are called *Chile Gordo* and *Serrano*. They are small in size and to the North American tongue, extremely biting. Generally these peppers are preserved in vinegar and serve as both sauce and condiment.

At the end of the first year's growth approximately 5 percent of the young plants bear fruit. But this only occurs in the fields that were set out in the previous July, or in the early part of August, this first-year fruiting being a premium enjoyed only by those who plant early.

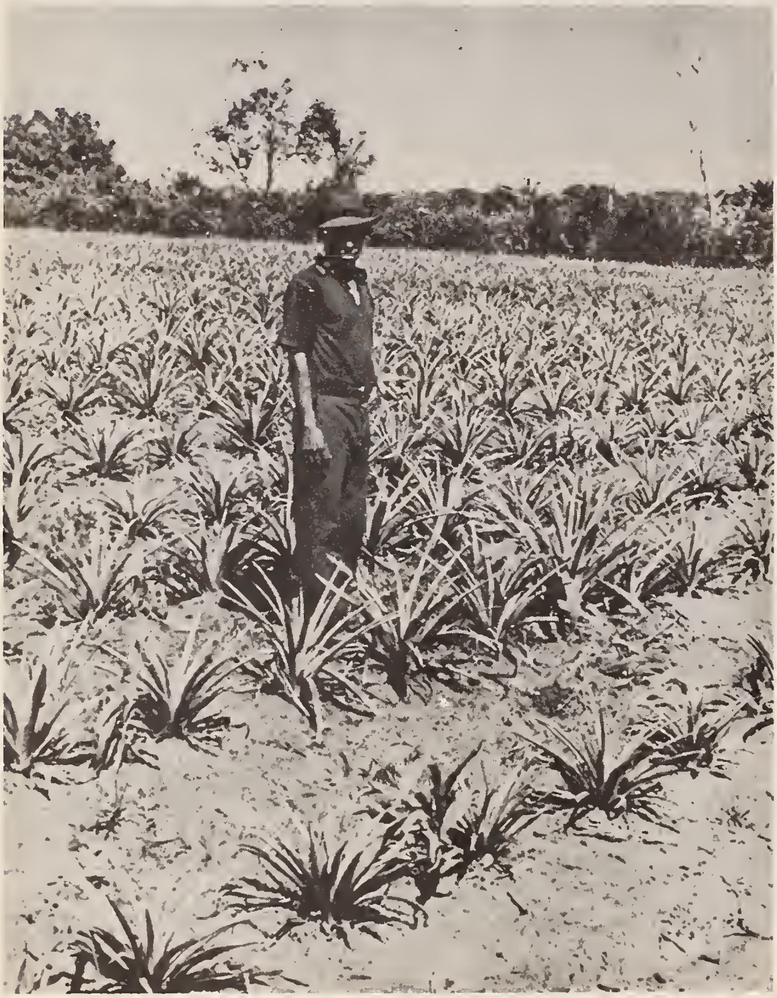


FIGURE 86.-Five-month-old pineapple plants at Loma Bonita.

Plants set out in late October or November rarely, if ever, bear fruit in the first year. Moreover, an additional advantage is gained from early planting. Plants that bear fruit at the end of the first year usually send out two or more suckers. At the end of the second year these suckers likewise produce fruit, in addition to the parent plant. During the second year of growth it is not possible to plant intercrops, because the rows of pineapples have by this time closed in fairly well.

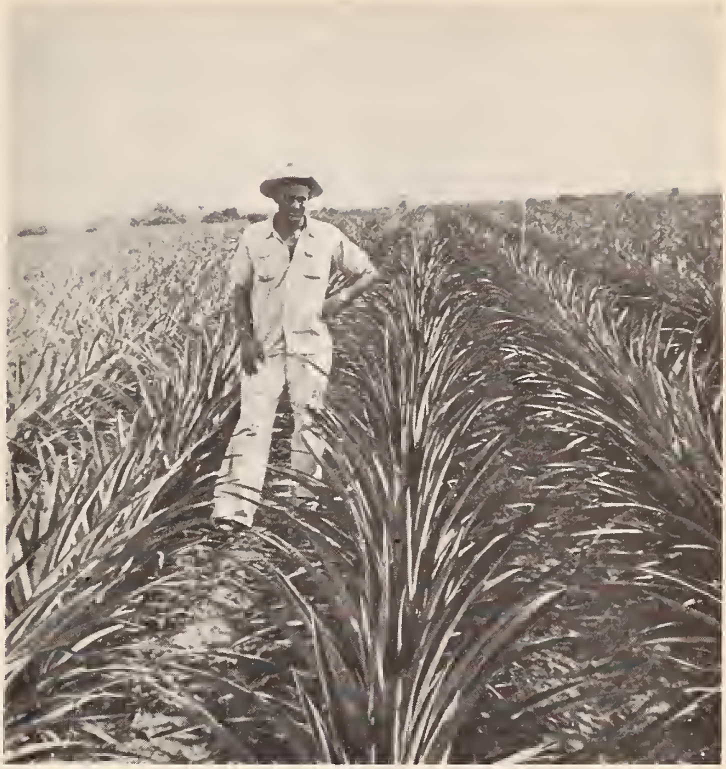


FIGURE 87.-Mr. Ed Hughes in his field of 1-year-old pineapples.

In the course of the first year, cultivation takes place eight times, an average of once every 6 weeks. A cultivator drawn by oxen is used for heavy work. A spud is employed to loosen the soil around the base of the plants and at the same time to cut out weeds.

During the second year six cultivations are made on up-to-date farms. The general practice is, however, to cultivate only four times in the second year.

Fertilization. To date fertilizers have not been used in the principal producing areas of Mexico. Because of the natural fertility at Loma Bonita, together with the abundance of new land, they have not been necessary. In the region near Isla, Veracruz, small plots have been given fertilizer, with fair results up to the present. Its widespread use is, however, far from being included in the general cultivation scheme.

In checking over the Mexican production estimates for the past 18 years, one fact stands out. Production has more than doubled, going from 18,000 to over 50,000 metric tons (19,800 to 55,000 short tons). In the same span of years yields per hectare have steadily decreased. Data from the Mexican Department of Agriculture indicated that the average yield per hectare for the Republic in 1925 was 34 metric tons (15 short tons per acre). By 1941 it had fallen to 17 metric tons (7.5 short tons per acre), a reduction of 50 percent.

As mentioned previously, little or nothing has been done to improve the stock. The use of poor suckers and lack of selection in plant material undoubtedly have had a part in the decrease in yields. At the same time continued cultivation of the same field without the addition of any fertilizer has further assisted in cutting yields. Although this declining yield has not been a problem at Loma Bonita, where new land is available for cultivation, agrarian difficulties have held plantings fairly close to the towns. Thus new land has not been utilized as much as it could be.

Another factor that has limited yields is the growing practice of planting intercrops of chili peppers, beans, and corn. Four crops in the same field have resulted in a rapid sapping of the soil.

Some discrepancy appears between government figures on yields and those reported by the farmers in the growing areas. A farmer, who had kept records on production for over 10 years, stated that he consistently netted yields of 37 metric tons per hectare (16.5 short tons per acre) from his land. In his opinion average yields at Loma Bonita ran about 28 metric tons per hectare (12.5 short tons per acre) against the government figure of 22 (9.8 short tons per acre).

Insect pests and diseases. Generally speaking, insect pests present no grave problems to the pineapple industry. In Loma Bonita a small gray-colored moth lays eggs in the crown of growing plants. This moth is only noticed after the regular rainy season ends and cooler weather prevails. The eggs laid by the moth result in small pink worms that feed on the tender inside leaves of the plant. As soon as the weather becomes warmer, trouble with the insect ceases. To date, the amount of damage caused has not been large, but as yet no successful method has been developed to halt the attacks of this insect.

The common fungus, *Thielaviopsis parodoxa*, causes some trouble. Experiments are reported under way, which are directed toward obtaining a variety more resistant to the fungus. If any concrete results have been obtained, the information has not been disseminated through the producing areas.

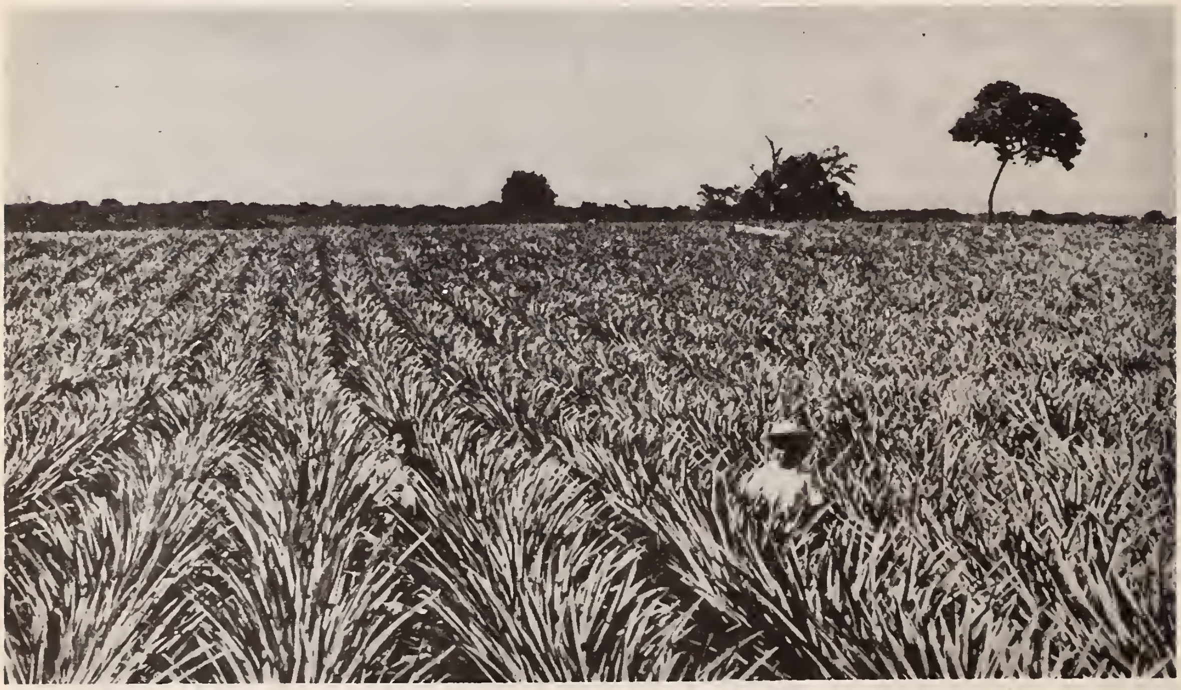


FIGURE 88.-Fully matured pineapple plants 2 months from the time of harvest. This field is located in the most fertile section of the Loma Bonita area.

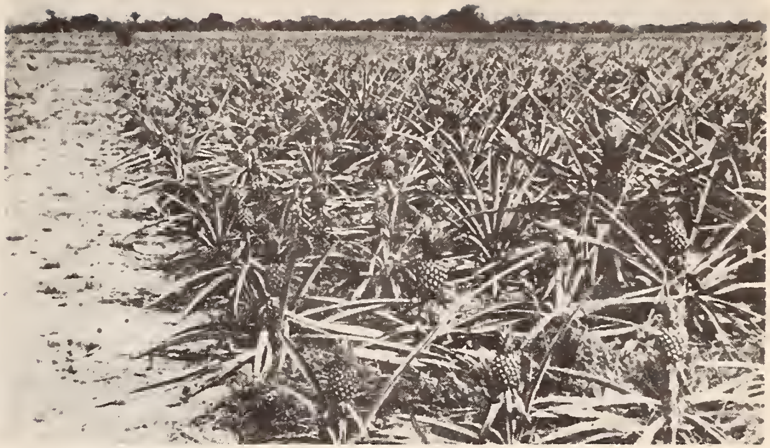


FIGURE 89.-Pineapples ready for harvesting.

Harvesting. Pineapples are harvested during every month of the year in Mexico, but the same quantity of fruit is not harvested each month. About 45 percent of the national production is cut during June and July. Another important harvest during the winter months of December and January accounts for 20 percent. Production is low in September, October, and November and again in February, March, and April. In the most important section, Loma Bonita, cutting begins about May 10 and continues until about the first of August. When this region was first planted 35 years ago, harvesting began the last week of April, about 2 weeks earlier. The degeneration of stock, plus no attempt to fertilize the soil, has probably delayed maturity.

Toward the end of the growing season, when the pineapples attain full weight, they have a tendency to lean over. To prevent sunburn and uneven ripening of the maturing fruit a covering of straw is placed over the plant.

No particular type of knife is used for cutting the fruit. A number of workers use an ordinary table knife with a keen edge.

After the fruit is cut, it is brought to a central point in the particular field and loaded on an oxcart. The bottom and sides of the cart are covered with straw to prevent damage to fruit in transit from fields. Although the haul is usually short, this precaution is necessary, because the cart bounces up and down almost as much as it goes forward over the rough roads through the fields. While refrigerator cars ("reefers") would be preferable for export shipment, only a few are used. and the necessary number of reefers is difficult to obtain. Costs run higher, for an additional charge of 25 percent must be paid for hauling reefers, and another charge of 5 centavos per kilometer (about 0.2 cent per mile) is assessed for moving an empty car.

Almost all the fruit is moved out in regular freight cars. Shippers are willing to accept anything that will transport the fruit. Even so, heavy losses occur each year

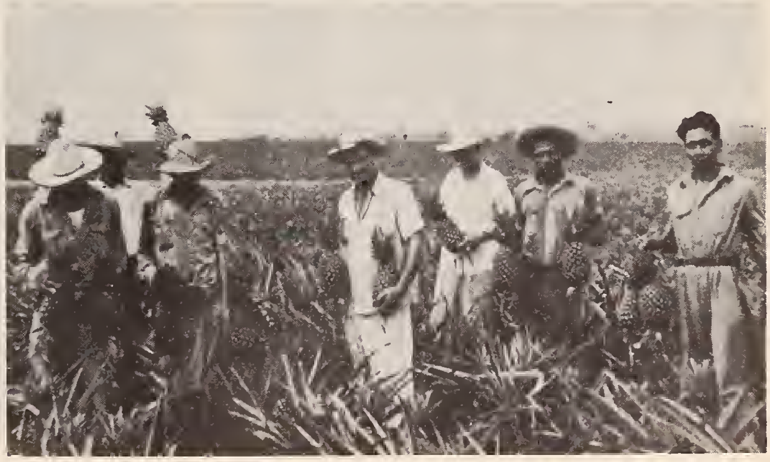


FIGURE 90.-Harvesting pineapples at Isla.

because adequate transportation facilities are lacking at the proper shipping time. As mentioned before, 20 percent of the 1941 crop went to waste, and losses were even higher in 1942, when they were reported at 40 percent.

At one time crates were used much more than is true today. The type of crate used previously provided space for only eight large pineapples and resembled the type used in California to ship oranges. Crates have now been largely abandoned, because, first of all, they receive hard treatment, and replacement costs are high. Second, and most important, pineapples are exported more cheaply when simply nested in cars.

The fruit cars move from Loma Bonita to Córdoba; then they are hauled up to the central plateau by the Mexicano railway, which uses electric engines for the steep climb. Córdoba is the icing center for both banana and pineapple cars in transit to the United States. All fruit is shipped over a standard-gage track. Little, if any, goes via Veracruz.

It usually requires 7 days to transport fruit to the border from Loma Bonita. To Mexico City an average of 3 days is necessary. However, because of delays, it sometimes takes up to 11 days for the fruit to reach Laredo, Texas. At times cars wait on sidings at loading points 3 days before a locomotive arrives to haul them to the market. At 85° F. fruit breaks down rapidly in a freight car where there is little circulation of air.

Costs of Production

Throughout the pineapple-producing areas the common daily wage paid to field workers is 2 pesos (41 cents). This may vary somewhat, but it rarely drops below

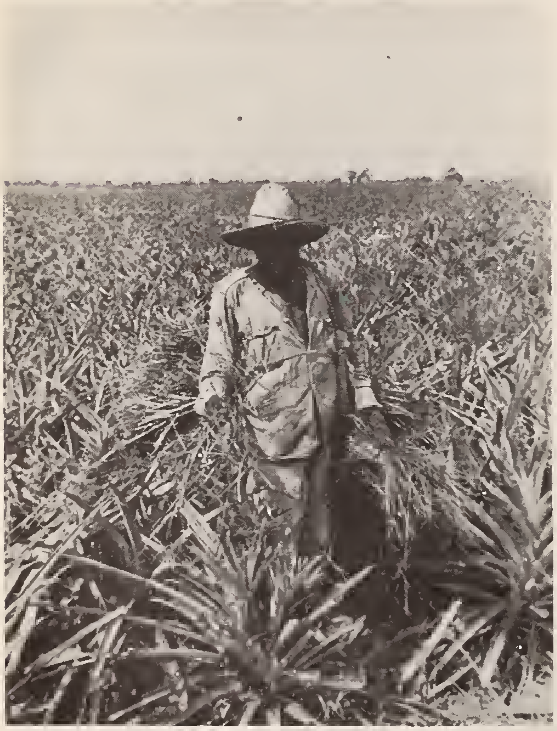


FIGURE 91.-Covering pineapples with straw to prevent sunburn.

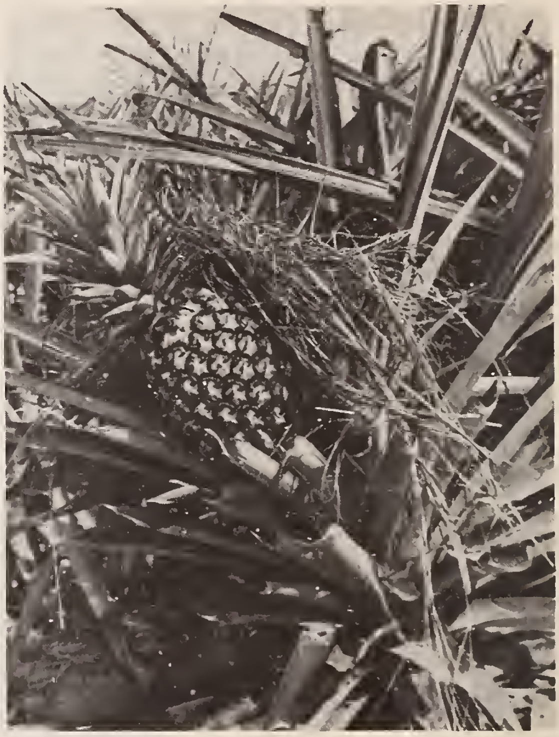


FIGURE 92.-Maturing pineapple covered with straw.

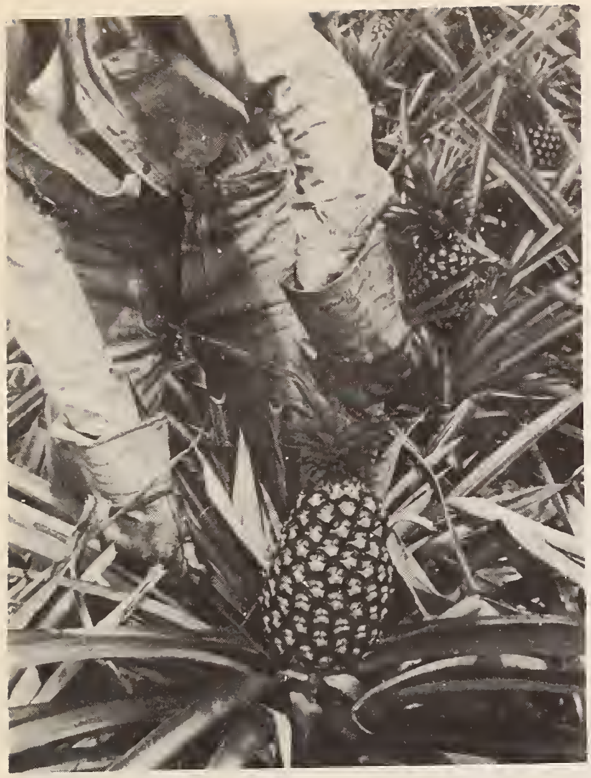


FIGURE 93.-Cutting pineapples.

1.75 pesos (36 cents) per day, or exceeds 2.50 (51 cents). This wage rate is based on an 8-hour day that usually begins shortly after daybreak.

The chief sources of power for farm work, as previously mentioned, are oxen. Mules, burros, and horses are seldom used. Since results from tractors proved disappointing, due to ill use of this equipment, oxen now supply all the power for preparing and cultivating the fields.

Generally, from 6 to 7 pesos ($1.23 to $1.44) a day are paid for a team of oxen, depending on the type of work. In hauling pineapples from the fields to the station, charges are made on the basis of each pineapple carried. For example, those farmers whose fields are within 3 kilometers (1.9 miles) of railroads pay 1 centavo for each pineapple. For hauls of from 3 to 6 kilometers, the cost is 1.5 centavos (0.3 cent) per pineapple.

Annual rates for renting a hectare (about 2.5 acres) of land run from 5 to 7 pesos ($1.03 to $1.44). Most growers prefer to rent land, but a good portion can be purchased in partial payment of back taxes. The price is usually 20 pesos per hectare ($1.66 per acre). Good agricultural land upon which taxes have been paid can be bought from 20 to 35 pesos per hectare, depending on its location and fertility.

If a farmer wishes to borrow money from a bank to finance his crop, he may do so only if he is a member of one of the larger cooperatives. Loans by banks to individual farmers are not granted. The usual loan granted to farmers belonging to cooperatives is at the rate of 1 centavo (0.2 cent) per pineapple at 10-percent interest. Before a loan can be obtained, the bank sends inspectors to look over an applicant's

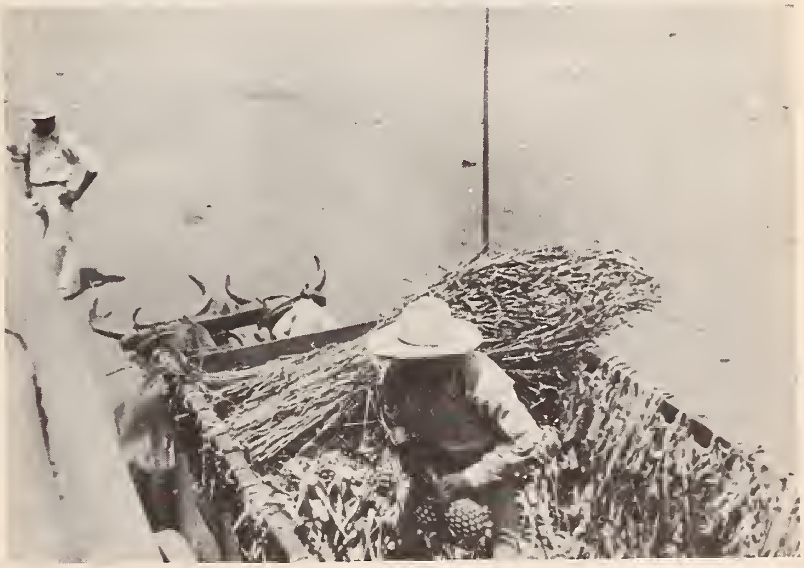


FIGURE 94.-Loading pineapples into an oxcart.

fields; at the same time a check is made with the cooperative to find out the status of previous deliveries made by the applicant. In this way the bank makes an inspection of the farmer's ability to produce and deliver. Moreover, all the loan is not extended at one time but at intervals. For example, after the first year's growth, so much is granted to the farmer; before harvest, another sum is extended.

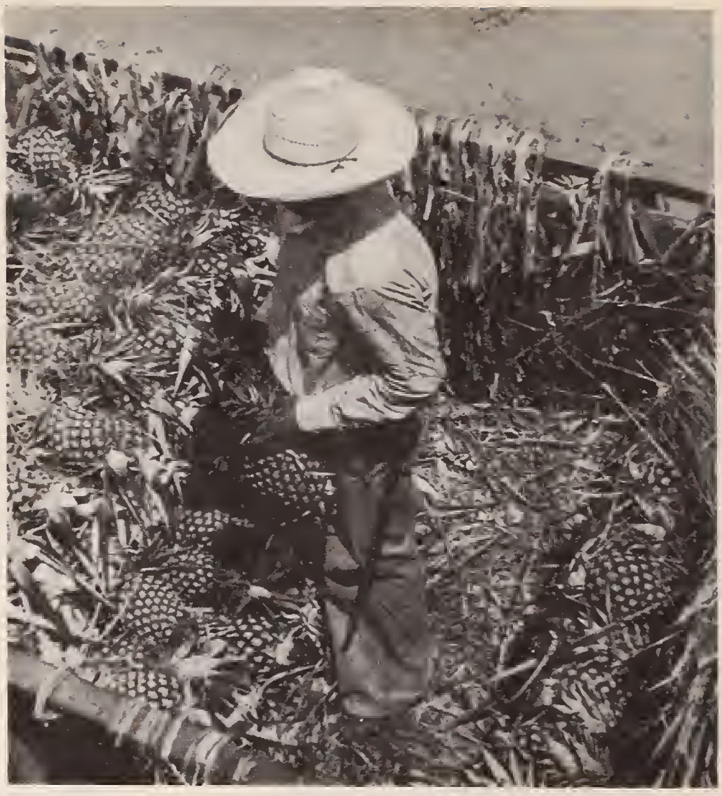


FIGURE 95.-View of oxcart used in loading pineapples.

A small grower, or ejidatario, is not in a similar position in the eyes of the bank. His only recourse is to make an arrangement with one of the commission men of the village. Loans are generally not large, but interest rates are high, sometimes as much as 15 to 20 percent. The usual result is that a commission agent comes into possession of the small grower's crop at a cost to himself of only 20 to 25 pesos a ton, about half the amount gained by the larger growers.

The assessed valuation of pineapple land generally runs about 10 pesos per hectare (83 cents per acre). Taxes, including both state and federal, amount to between 0.45 and 5 percent of the assessed valuation. The following taxes were paid by two individuals still holding land at Loma Bonita: "A," whose 400 hectares (988 acres) of land had an assessed valuation of 3,974 pesos ($817), paid 84 pesos ($17.27) last year; "B," who also held 400 hectares, assessed at 4,200 pesos ($863), paid 88.20 pesos ($18.13).

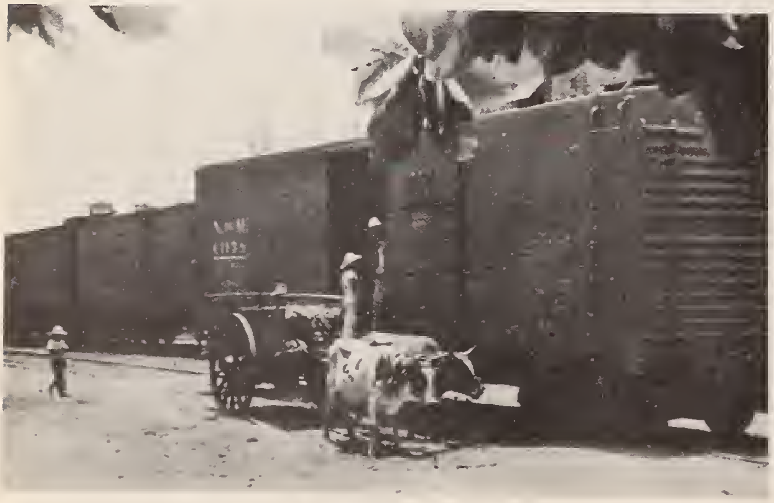


FIGURE 96.-Transferring pineapples from oxcart to boxcar at Loma Bonita.

Data covering the cost of each operation in the production of pineapples from the initial clearing of the land to the delivery of fruit at the railway station for shipment indicate a total expenditure per acre of 387 pesos or nearly $80 during a 2-year period. (See table 16.)

Consumption

The Mexican Department of Agriculture estimates that 75 percent of the total 50,000 tons of fruit now harvested annually is shipped from growing areas to fulfill requirements of domestic and foreign markets. Of this 75 percent, or 37,500 tons, probably 60 percent originates in the Isthmus of Tehuantepec. Loma Bonita, Isla, Tigres, Palo Isacho, Obispo, Sarabia, and Mogoñe are the principal shipping points. The above-cited governmental figures appear to be very generous estimates of actual quantities shipped. A survey of the growing districts indicates that the shipments run closer to 60 percent than 75 percent of the yearly production.

For the 15 years 1925-39 apparent domestic consumption averaged 23,000 metric tons (about 25,000 short tons) a year. For the first 10 years of this period it amounted to about 18,000 tons yearly. After 1935, following a rise in production, it averaged close to 28,000 tons. During the past 3 years a new increase became evident, and now domestic consumption is averaging over 32,000 tons a year.

These figures are based on a statistical disposition of pineapples arrived at by deducting total exports from total domestic production. This break-down gives only a rough indication of the disposition of the fruit. Actual consumption is another thing. Because of lack of transportation facilities, glutted markets at the height of harvest, and relatively high prices when fruit is plentiful, from 20 to 40 percent of the yearly production of pineapples never leaves the growing centers. This fruit is entirely wasted; much of it rots in the field or at points of shipment. (See table 17.)

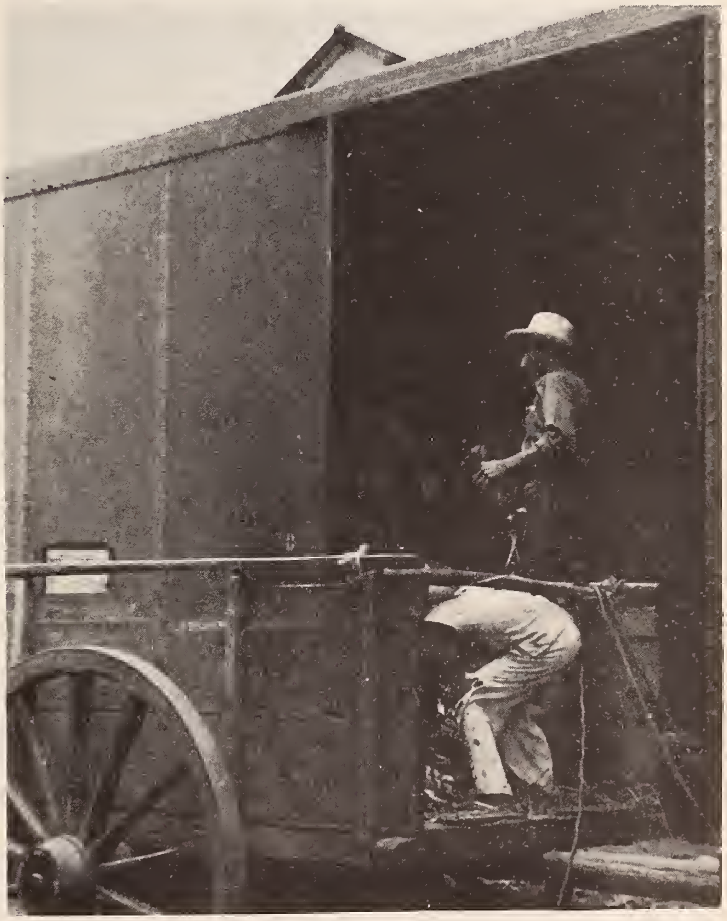


FIGURE 97.-Loading pineapples into boxcar at Loma Bonita.

Prices

Prices paid to producers over the past 10 years have averaged about 8 centavos per

TABLE 16.-*Cost of pineapple production in Mexico*

ITEM	COST PER HECTARE[1]	
	Pesos	*Dollars*
First year:		
Rent	5.00	1.03
Clearing off brush	35.00	7.22
Burning and clearing off residue	5.00	1.03
Plowing	25.00	5.15
Harrowing	5.00	1.03
16,000 suckers at 9 pesos per 100	154.00	31.75
Hauling suckers to field	8.00	1.65
Planting - 2 pesos per 1,000 at 15,000 per hectare	30.00	6.19
8 cuttings of grass and weeds before each cultivation per hectare	160.00	32.99
Cultivation - 8 times at 8 pesos per hectare	64.00	13.20
Total cost	491.00	101.24
Second year:		
Rent	5.00	1.03
6 cuttings of grass and weeds at 20 pesos each	120.00	24.74
6 cultivations at 8 pesos each	48.00	9.90
Fire guards around hectare	2.00	.41
Trimming every two rows to aid in harvesting	2.00	.41
Harvesting - 15,000 pineapples per hectare	60.00	12.37
Hauling 14,500 pineapples from field to station (loss 10 percent in fields - 15,000)	145.00	29.90
Grass for padding pineapple carts	5.00	1.03
Total cost	387.00	79.79
Total cost for both years	878.00	181.03
Cost per acre	355.26	73.26
Cost per pineapple	.06	.01

[1] Exchange rate 4.85 pesos to $1; 1 hectare is equivalent to about 2.5 acres.

Costs of production are based on figures obtained from one of the more progressive growers in the Loma Bonita Section. They probably run somewhat higher than expenditures by other growers in the same region.

kilogram (0.8 cent per pound) according to data issued by the Mexican Department of Agriculture. This figure is believed to be high. For example, contracts for foreign sale in 1942 were at 63 pesos per metric ton, or about 6.5 centavos per kilogram (0.7 cent per pound). Average domestic contracts ran considerably under this figure. Off-season prices bring better returns to the farmer. Prices for winter fruit average from 80 to 100 pesos per metric ton ($15 to $18.66 per short ton).

These prices are those paid to the cooperatives and do not represent net returns to the producers. The cooperative charges the grower a percentage for handling his fruit. Thus, while the contract may bring 63 pesos per metric ton ($11.76 per short ton), the producer only receives about 55 pesos ($10.26 per short ton).

The 1942 price of 63 pesos represents the best return paid to farmers in over 10 years. This price was, however, enjoyed by only those producers who belong to the larger cooperatives. The average price paid to the small growers, or ejidatarios, who contribute over half the national production, was 38 pesos per metric ton, or about 4 centavos per kilogram.

An effort was made to obtain price series for both wholesale and retail sales in Mexico, D. F., but data along this line are apparently unavailable. The only information obtainable is that gathered by personal tours of the wholesale markets and by interviews with fruit jobbers. At the height of the season in June and July the price per 100 pineapples, the usual wholesale measure, averaged between 17 ($3.50) and 27 pesos ($5.55). The retail price for a 2.5-pound fruit ran about 30 centavos (6 cents). The off-season price for a pineapple of the same weight may run as high as 1.20 pesos. These quotations serve to indicate the price trend, but cannot be considered exact to the centavo.

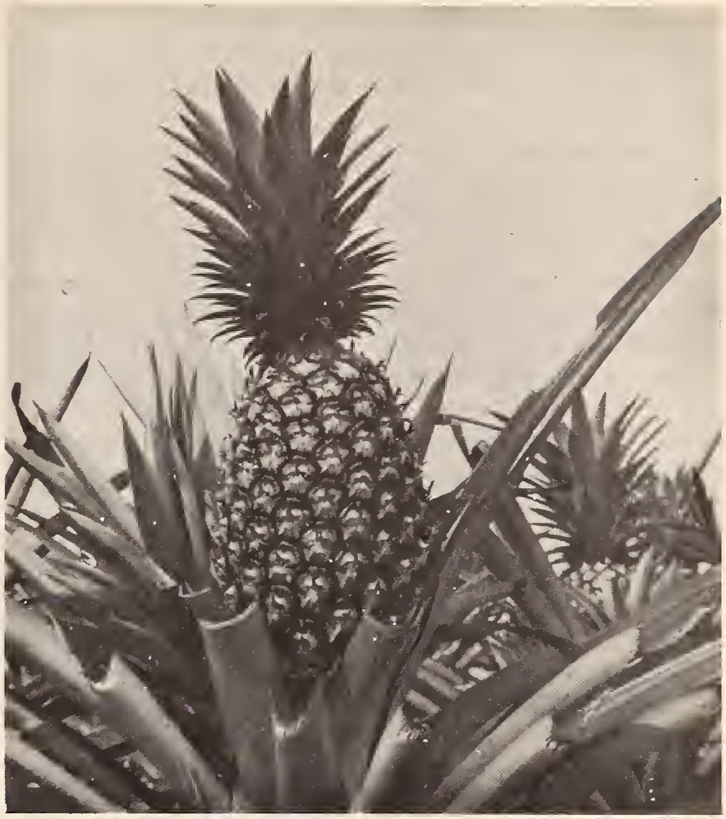


FIGURE 98.-Pineapple from Isla weighing 4.6 kilos (10.1 pounds).

Marketing

Except for special orders, all pineapples are shipped to the market in bulk. The Isthmus of Tehuantepec must necessarily ship all its fruit by rail, but fruit grown near Córdoba in Veracruz and in the Huasteca region of San Luis Potosí and Hidalgo, is moved to domestic markets by truck. Sometimes, but not generally, cars are lined with grass to protect fruit in transit.

With the exception of export pineapples, which must weigh from 2.5 pounds upward, no grading of fruit is practiced. At loading points only the spoiled fruit is thrown out. All the rest is shipped to the domestic market.

On arrival at one of the domestic markets, the fruit is usually disposed of quickly. Many of the sales are made directly from the freight cars. Larger dealers generally make some previous arrangement with representatives of the growers' unions and may work on a full-car basis. Smaller wholesalers buy a fourth or half car on arrival and then haul the pineapples to small stalls, where the public and retailers

TABLE 17.-*Apparent domestic consumption and waste of pineapples in Mexico, 1925-42*

YEAR	QUANTITY		YEAR	QUANTITY	
	Metric tons	*Short tons*		*Metric tons*	*Short tons*
Average			1937	35,724	39,379
1925-29 . .	17,961	19,798	1938	30,393	33,502
1930-34 . .	19,769	21,791	1939	24,392	26,887
Annual			1940	31,397	34,609
1935	30,162	33,248	1941	41,059	45,259
1936	36,082	39,773	1942[1]	43,000	47,399

[1] Estimated.

Compiled from records of the Department of Estadística de la Economía Nacional.

come to buy. No use is made of warehouses or cold storage in connection with pineapples. Even if cold storage were desired, facilities are not adequate in Mexico City, the chief market for fruit of the Republic. In the smaller cities they are virtually nonexistent.

As with other agricultural produce, age-old systems of distribution and sale are still in vogue in Mexico. For example, fruit is taken to the Merced Market, one of the large public markets of Mexico, D. F., and small vendors and retailers haggle over the price of 50 kilos (110 pounds) or less of pineapples. Sales are small. As explained before, only the larger dealers can afford to handle a whole car at a time. The small individual vendor, who handles a basket of fruit a day, may purchase half a dozen pineapples along with oranges, limes, apples, and melons. In many instances he will carry this basket halfway across the city to the corner where he sells his fruit. Or he may carry it to one of the other markets and sell it from his own stand. The bulk of fruit is sold in this manner. Actual fruit stores, as they are known in the United States, are patronized by the upper classes only, and important shops in Mexico, D. F., are not more than 10 in number.

Generally speaking, individual farmers do not send their fruit to the central markets. Most of the fruit is handled on a contract basis. It is sold to commission men, f.o.b. at a loading station, in the growing district.

Since expropriation and the creation of laws favoring cooperatives, contracts between individual growers and commission men are rare. Usually the contract is between the cooperatives and the buying agent. Cooperatives do not market the fruit themselves. As far as is known, the only exception to this statement is the largest growers' union at Loma Bonita, which sends a representative to Mexico City to dispose of fruit left after all contracts have been fulfilled.

The fact that growers have no better way to market their produce has always been a hindrance. Usually the commission men who buy large quantities of fruit can name their own price. Since the growers have no information or knowledge regarding the market side of the industry, they have no other recourse. Complaint of this situation is widespread in all the country districts. When the farmer is informed of the price his fruit brings in Mexico City and particularly in the United States, he feels that gains by the middleman are too high. As conditions exist today, however, a long time must elapse before the farmer can do anything to remedy the situation. With many people in the country districts still not able to read and write, the complex task of marketing still remains outside their control.

Contracts made within Mexico are on a much smaller scale than those arranged for the export market. A fairly large domestic contract will amount to 200 metric tons at a price of 45 or 50 pesos a ton, but many sales are for less than 50 tons. One of the largest foreign contracts, on the other hand, was for 6,000 tons at 63 pesos a ton.

Although the *piña* flavor is well known in the *refrescos* of the lower classes, widespread consumption of fresh pineapples among these groups is not high. Bananas, oranges, and mangoes are leaders in this connection. Pineapples can never be purchased by the public at particularly low prices. Even in the height of the season a good-sized pineapple will cost around 30 centavos. When one takes into consideration that the average urban worker makes only 100 pesos (about $20.50), or less, per month and has a family of two or more children, it is not surprising that the less expensive fruits move more rapidly.

The common practice is to sell sliced pineapple in the poorer section of the town. A slice, or *rebanada*, costs 5 centavos. Fruit dealers in Mexico City state that the volume of fruit consumed in this manner has shown a steady increase.

Another drawback that impedes the widespread use of fruit is the Mexican dietary scheme. To change the habits of a populace that has lived on corn, beans, chili, and rice for generations is not an easy task, even if the pineapples were distributed without cost. Domestic sales and consumption have not advanced in proportion to the rapid rise in foreign trade in this commodity. Domestic consumption has, however, picked up somewhat in recent years through the establishment of canneries, which pack fruit.

Canning Industry

There are four principal canneries engaging in packing pineapples at present. Two of these are in Mexico City. One is found in the State of Guanajuato, at Salamanca, and the other is located southeast of Mexico, D. F., at Puebla. The concern in Salamanca is reported to be the largest packer, followed by the firm in Mexico City.

The size of the annual pack is hard to estimate with accuracy. Government statistics in this regard place all fruit used for canning in the same category. For example, there is no break-down for the various fruits, such as mangoes, peaches, apricots, plums, and pineapples. Estimates of the four packers are at variance with one another regarding the size of the yearly pack. Likewise concrete information from the trade leaves much to be desired.

The data regarding canning of pineapples appear to be approximately as follows: For the past 10 years pineapples have been packed in quantities worthy of mention. In 1936 the total pack for the Republic did not exceed 50 tons. By 1939 it had increased to about 1,000 tons. In 1940 the pack was double the 1939 figure, and by 1941 some 3,000 tons were canned. In 1942 a reduction occurred. This resulted from the scarcity of tin plate, which Mexico does not produce. Since more tin plate has been allocated for export to Mexico during 1943, the pineapple pack is expected to be larger for the current year.

The larger canneries make contracts with the big producers' union at Loma Bonita, Because pineapples have to be graded for canning purposes, prices per ton run higher than for fruit bought under ordinary contracts. For example, packers pay from 60 to 70 pesos ($12.34 to $14.40) a ton for selected fruit against the average price of 45 pesos a ton.

Smaller packers, who cannot handle a whole car at a time, buy the fruit upon arrival at one of the central markets. They generally pay 90 to 100 pesos ($18.51 to $20.57) a ton to a fruit broker for the privilege of sorting out the best fruit.

Over 95 percent of the packing takes place during May, June, and July. The remainder is completed in December, during which month small shipments of winter fruit reach the market.

Only the upper classes can afford to buy canned fruit in Mexico. Prices are beyond the reach of average members of the lower classes. A 2½-size can of pineapples that has been packed domestically currently sells for 1.70 pesos (35 cents). Canned pineapples imported from the United States sell at still higher prices.

Small shipments of canned pineapples have moved to the United States since the outbreak of the war, which, according to the sellers, consisted mostly of crushed fruit. As the food situation grew tighter during 1942 in the United States, the volume of canned goods leaving Mexico increased. Price has not been a particular consideration; in a recent case, a buyer from the United States was reported to have paid a higher wholesale price for a lot of No. 10-size cans of crushed pineapple than the current retail price. When a stock of pineapple is uncovered, it is immediately purchased.

Of the larger quantity of pineapples expected to be packed this year, the trade indicates that a good portion will eventually go to the Army and Navy. Most of this export pack will probably be in large cans (No. 10), made up entirely of crushed pineapple.

A new canning factory is in process of being installed at Isla. It will be devoted especially to the packing of pineapple. It was slated to go into production in May 1943. Early reports state that it will be able to handle some 3,000 metric tons (3,300 short tons) of fruit annually, but if half that amount of pineapples were canned in 1943, the plant had a good year.

The establishment of a plant in the heart of the producing region is a step in the right direction. Its location will serve to eliminate many of the difficulties now experienced by the plant at Mexico City. Moreover canned fruit can be moved during slack periods of the heavily taxed Pan-American Railroad.

Foreign Trade

The United States has always been by far the best customer for Mexican fresh pineapples. The only other large buyers in the past were France, Germany, and Canada, but sales to these latter countries were spasmodic in nature. Exporters report that shipments by sea were not particularly successful. Generally the sea voyage to Europe required a minimum of 12 days, and the freighters engaged in this service were not fitted to carry fruit under refrigeration. The pineapples were handled several times more than is necessary on the shorter railroad haul to the United States.

Exports to the United States increased from 116 thousand pounds in 1930 to some 21 million in 1941. (See table 18.) The first large shipment was in 1934, when 3,600,000 pounds crossed the border. Another sharp rise occurred in 1936, when 13,200,000 pounds left Mexico for the United States. Since that date exports have shown an almost regular yearly increase.

Export shipments begin in the middle of May and continue until September. Total exports during June are greater than those of May, July, August, and September combined. In 1942, about 11 million pounds moved during June against 9 million during all the other months.

Until means of transporting pineapples can be improved, a great increase in exports cannot be expected. The Loma Bonita region can produce a much larger crop

TABLE 18.-*Exports of fresh pineapples from Mexico by countries of destination, 1930-42*

YEAR	UNITED STATES	CANADA	GREAT BRITAIN	GERMANY	FRANCE	OTHERS	TOTAL
	1,000 pounds	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*
1930 . . .	116	-	-	-	-	1	117
1931 . . .	219	-	-	-	-	-	219
1932 . . .	188	-	-	-	-	-	188
1933 . . .	1,248	-	2	7	-	-	1,257
1934 . . .	3,595	-	-	-	-	-	3,595
1935 . . .	5,491	-	6	61	29	3	5,590
1936 . . .	13,235	-	-	154	-	-	13,389
1937 . . .	15,321	-	-	-	-	-	15,321
1938 . . .	13,234	38	-	-	-	-	13,272
1939 . . .	18,286	-	-	-	-	-	18,286
1940 . . .	19,437	-	-	-	-	-	19,437
1941 . . .	20,883	-	-	-	-	-	20,883
1942 . . .	20,014	-	-	-	-	-	20,014

Compiled from official sources.

than at present. The physical set-up is ideal for an increase in production, but better railway service must be secured. Farmers who ship from smaller sidings state that a delay of 2 or 3 days after the car is loaded is not uncommon. When pineapples start coming in, they come all at once. Unless cars are provided, waste occurs, and waste has been increasing yearly. To top off the trouble, in 1942, a bridge wash-out in July held up shipments for over 3 days. Partially because of this incident, plus difficulties in obtaining cars at the right time, 40 percent of the fruit was spoiled.

Export data covering the movement to the United States for the years 1940 through 1942 show that 1941 was the best of the 3 years both as to volume and value of pineapples shipped out. The slight decline in 1942 was, as already noted, the result of wartime shipping conditions,

All the export fruit is shipped out in bulk, being simply nested in the cars. On the average some 5,500 fruits are shipped per car. In moving fresh pineapples from Loma Bonita to the border about 20 percent go in refrigerator cars, and the remaining 80 percent are regularly shipped in boxcars or cattle cars. Shipment of fruit by reefers costs an additional 25 percent. Moreover, it is necessary to pay 176.20 pesos ($36.24) for hauling the empties from Laredo down to Loma Bonita. The shipping rate is based on a minimum weight of 12,500 kilos or 28,000 pounds.

The largest domestic consuming center for pineapples is Mexico City, and the freight charge from Loma Bonita to the capital of the Republic is 19.60 pesos per metric ton ($3.66 per short ton). There is an additional hauling charge of 10.50 pesos ($2.16) per car.

The freight charge per metric ton for shipping fruit from Loma Bonita to Laredo is 27 pesos ($5.03 per short ton). There is a charge of 22.50 pesos ($4.63) for hauling a car from the producing region to the United States border. The cost of shipping one freight car of pineapples from Loma Bonita to the Texas border during 1942 amounted to 1,650.79 pesos (about $340). The cost per refrigerator car totaled 1,707.59 (about $352). (See table 19.)

TABLE 19.-*Shipping costs of pineapples moving from Loma Bonita, Mexico, to Laredo, Texas, 1942*

ITEM	COST		ITEM	COST	
	Pesos	*Dollars*		*Pesos*	*Dollars*
12,500-kilo car at 13.00 U. S. dollars per metric ton	788.13	162.50	Freight at 27.99 pesos per metric ton on a 12.5-ton car	349.88	72.14
Federal freight tax at 12.2 percent	45.43	9.37	Aforo - export tax at 12 percent	45.00	9.28
Hauling car	22.50	4.64	Charges at Nuevo Laredo .	21.83	4.50
Switching charge	45.78	9.44	Charges at Laredo	21.83	4.50
Customs brokerage	70.33	14.50	Total: Freight car . . .	1,650.79	340.37
U. S. duty	240.08	49.50	Refrigerator car.	1,707.59	352.08

Compiled from official sources.

Only one organization has been granted a subsidy covering the regular export duties. The large *Union Nacional de Cosecheros de Piña* is the favored cooperative in this regard. Other exporters are obliged to pay the export duty now in effect.

While the *Union Nacional de Cosecheros de Piña* does not have to pay export duty, it is charged the *aforo*, or export tax, on fruit shipped to foreign markets. *Aforo* valuation of pineapples leaving Mexico has shown some wide variations over the past 5 years. The amount paid is 12 percent of the aforo valuation.

Changes in Mexican customs duty (pesos per 100 gross kilograms) on pineapple exports:

Tariff number	Item	Before 1925	Effective date		
			10/30/26	9/1/39	4/1/41
73	Unspecified fresh fruit	Exempted			
78 A	Pineapples		Exempted		
24-58	Pineapples			2.50	
24-58	Pineapples				4.50

By a reciprocal trade agreement of December 23, 1942, between the Governments of Mexico and the United States, the American import duty on fresh pineapples was reduced to 0.8 cent per pineapple. The rate under the Tariff Act of 1930 had been 1-1/6 cents, and this has been reduced to 0.9 cent in other trade agreements prior to the United States-Mexican trade agreement.

Over half of all exports leave through the land port of Nuevo Laredo on the Texas border. Before the beginning of the war, Coatzacoalcos, a seaport in southern Mexico, was an important shipping point. Now, however, 100 percent of the fruit moves out of the country by land. The practice has been to unload a good portion of the freight cars at Monterrey in Mexico and load the pineapples on trucks and send the fruit out through Matamoros. Matamoros lies to the east of Nuevo Laredo on the Texas border. The only other land port worthy of mention is Ciudad Juárez, through which about 500 metric tons (1,102,300 pounds) of pineapples pass annually.

Future Developments

In spite of many difficulties, the Mexican pineapple industry has progressed remarkably well to date. The use of pineapples is increasing yearly. A number of problems must, however, be solved before this industry can go forward at a faster pace.

The most pressing problem that now confronts the Mexican pineapple industry is the necessary reliance on a decadent transportation system for marketing fruit. The Pan-American Railway system in its present state is unable to provide for the handling of large shipments of fruit during the peak months of the harvest. This problem is not a new one. Since 1935, when foreign shipments began to show promise, trouble has been encountered. As mentioned previously, in 1942 wastage amounted to 40 percent in June, the top month of the harvest. Piles of rotting fruit could be seen along the sidings throughout the Loma Bonita region. A minor problem has been a relative scarcity of freight cars. A lack of sufficient locomotives to haul the fruit to market is more serious. A general speed-up of the system would undoubtedly help. The big question has been and continues to be that of having the right amount of shipping space in the right station at the right time.

At the present time the Pan-American line is being repaired, but much remains to be done before it is put in working condition. The task will probably not be completed until the end of the war. Domestic consumption of fresh pineapples probably will not show any sharp increase during the next few years. Two conditions must change before heavier consumption can take place: First, the static Mexican dietary scheme must be altered; then more fruit must be eaten. Steps toward this end have begun. The Mexican Government through its health agencies has disseminated literature that explains the benefits derived from a more balanced diet. To alter dietary habits of 400 years' standing is, however, a slow process. Second, and more important, the lower-income classes must be given more purchasing power. Wartime conditions have brought about price increases for the basic staples - corn, beans, and rice. At the same time, wages have remained relatively unchanged. The purchase of such luxury items as pineapples under prevailing conditions is becoming more and more difficult.

Foreign sales of fresh fruit will probably continue to increase in volume as transportation facilities are improved. At present the usual 7 to 11 days required for transit from the growing districts to the border makes for heavy wastage.

The cures for this are a shorter delivery time and improvement of the now heavily taxed transportation system. The best manner in which to increase domestic production and utilization appears to be by establishing new canning factories. These canneries will necessarily have to rely on foreign sales of canned goods. Again, Mexican consumption of these luxury items is very limited. As mentioned in the section of the report devoted to pineapple canning and canneries, in Mexico the more important firms are located in the central plateau some 500 miles away from the producing area. This entails heavy expenditure in hauling the fruit to the cannery before processing takes place. The creation of a new canning factory at Isla was a start toward a more economical packing and canning system for pineapples. If this year's canning operations prove successful an attempt will probably be made to expand during 1944. This view appears to be on the optimistic side, when consideration is given to the present difficulties in obtaining machinery. Several benefits can, however, be derived from canneries established in this section. Canning stock can be bought at a more reasonable rate. Rural labor costs are considerably under those of the city, where the majority of the canning now takes place. The long haul of almost 500 miles is eliminated. Sugarcane and refineries are in the same district, thus providing necessary supplies of sugar.

As far as the actual physical conditions, such as soil, climate, and abundance of land, are concerned, there is no problem. Many more acres could be planted in pineapples in the 50-mile region that begins at Loma Bonita and follows down the railway past Isla. Today,

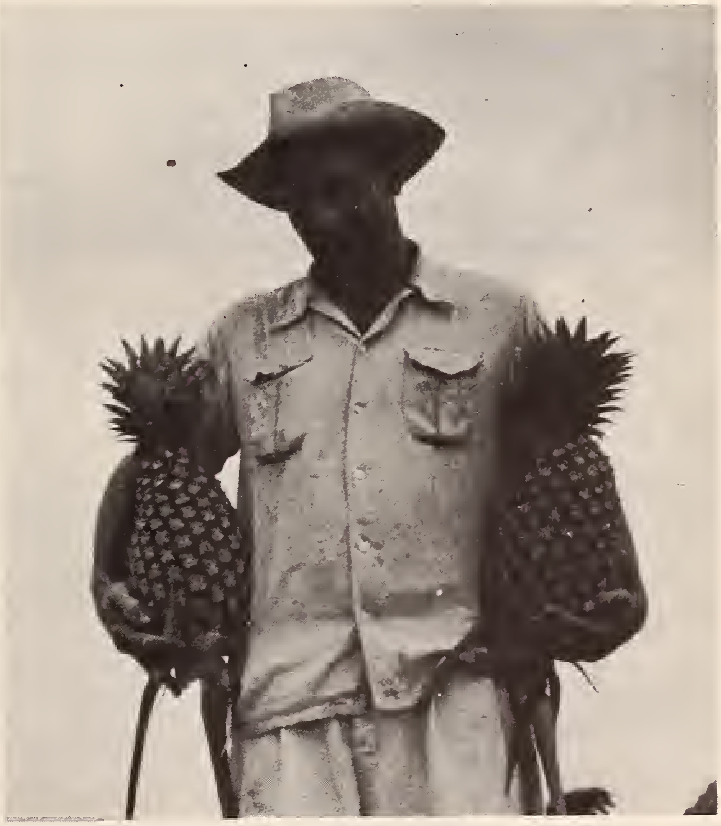


FIGURE 99.-Pineapples grow large in Mexico. These two specimens weigh 10.5 and 11 pounds respectively.

with a minimum of cars, virtually optimum results are obtained. In achieving these results, only the most primitive planting methods have been employed. A great deal of room still remains for plant investigation and scientific care in production. This need applies not only to pineapples; it is a necessity that encompasses all the agricultural crops of Mexico.

Standardization and grading of fruit could be applied, particularly to pineapples for canning purposes. Packing concerns of Mexico City state that a great deal of trouble is encountered in securing pineapples of uniform size. The No. 2½ can is the most widely used for sliced pineapples. If exceptionally large fruits are used for this type of pack, wastage is heavy. Some efforts have been made to use for crushed pineapple those parts of the fruit remaining after the choice central section has been removed. Since packing firms have no control over growing methods and the source of their supply, they must necessarily take whatever stock is available.

The discrepancies between prices paid in the rural district and those paid in the city must be changed; the width of the gap between rural and urban prices is too wide. Probably the best manner in which this situation can be improved is to have the producers enter to a greater degree into the field of marketing. This accomplishment is, however, still many years removed.

Concessions, subsidies, and freedom from state, municipal, and federal taxes have been previously granted to the large and powerful associations only. The small producers and ejidatarios do not enjoy similar privileges. Consequently, the produce must be marketed through one of the cooperatives, usually at a price lower than that paid to larger growers. This brings a cry that is voiced throughout the rural section of Mexico to the effect that the small producers are not being given an equitable share in the all-over sales of the pineapple.

In short, the above-described situation is characteristic of many rural districts. The land and the plants will produce if the farmers are given an opportunity to work with reasonable security. The security must be ensured by law and the prosecution of offenders.

OTHER TROPICAL FRUITS

Avocados

> "Four or five tortillas, an avocado, and a cup of coffee - this is a good meal," say the Indians of Guatemala. . . . To a certain extent, the avocado takes the place of meat in the dietary of the Central Americans. It is appetizing, it is nourishing, it is cheap, and it is available throughout most of the year.

So wrote Wilson Popenoe, Agricultural Explorer for the United States Department of Agriculture (*4*). He continued as follows:

> There is every reason to believe that eventually the avocado will be as familiar to American housewives as the banana is today. The increasing scarcity of meat, and the fact that an acre of land will yield a larger amount of food when planted to avocados than it will in any other tree crop known at present, assures the future importance of the avocado industry in this country.

When Mr. Popenoe made the latter statement, he had no thought of global war, meat rationing, black markets, etc., but he did visualize the importance of this fruit as a food and the part it was destined to play in American horticulture.

Unlike many tropical fruits, the avocado is no longer a stranger to most people living within the United States. While it cannot yet be regarded as a staple food,

TABLE 20.-*Number of trees and production of avocados in Mexico, by principal States, 1937-41*

STATE	NUMBER OF TREES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
Nuevo León . .	25	26	24	25	24	1,076	1,465	1,362	1,605	1,698
San Luis Potosí	28	28	32	28	29	1,362	1,521	2,248	2,175	2,260
Tamaulipas . .	12	10	12	13	14	360	519	809	1,235	1,163
Tabasco	17	14	14	14	16	1,336	1,186	1,428	1,437	1,566
Veracruz . . .	90	95	77	88	86	3,935	4,386	4,478	6,434	7,334
Yucatán	16	22	22	22	18	893	1,276	1,931	1,991	2,054
Chiapas	29	30	29	34	35	1,716	2,181	2,317	3,156	3,605
Guerrero . . .	21	20	20	18	18	1,660	1,264	1,237	1,732	1,638
Oaxaca	22	22	17	19	22	1,127	1,311	1,172	1,680	1,980
Guanajuato . .	18	23	22	22	21	1,249	1,781	1,842	1,691	1,693
Hidalgo	34	43	51	55	51	1,541	3,112	3,398	3,528	3,913
Jalisco	17	14	15	17	17	1,069	786	1,151	1,895	2,036
Mexico	77	76	77	82	73	3,679	2,848	5,498	5,038	5,632
Michoacán . . .	67	77	82	91	102	3,479	4,967	5,623	6,650	9,052
Morelos	24	27	23	29	30	1,506	1,758	1,827	2,006	2,321
Puebla	56	73	73	75	78	2,880	5,007	5,918	6,345	6,627
Querétaro . . .	26	55	59	55	57	949	2,132	5,161	4,443	5,006
Others	35	43	42	48	44	1,893	2,886	3,265	3,845	4,258
Total	614	698	691	735	735	31,710	40,386	50,665	56,886	63,836

Compiled from official sources.

such as it is in Mexico, it is rapidly gaining in volume and popularity. The avocado belongs to the genus *Persea*, family Lauraceae, which means it is related to the cinnamon tree, camphor, and sassafras. There are three, possibly four, species of avocado: *P. americana*, *P. drymifolia*, *P. Schiedeana*, and *P. Pittieri*. The cultivated varieties are classified horticulturally in three races: The West Indian, the Guatemalan, and the Mexican. The West Indian and Guatemalan belong to the species *Persea americana*, whereas the Mexican race represents a distinct species, *Persea drymifolia*.

It is stated (*4*):

> The native home of the avocado is on the mainland of tropical America. *Persea drymifolia* is abundant in the wild state on the lower slopes of the volcano Orizaba, in southern Mexico, as well as in other parts of the country. The extent of its distribution is not precisely known. . . . Jacques Huber, in the Boletim do Museu Goeldi, says: "Everything indicates that the avocado, originally indigenous to Mexico, has been cultivated since immemorial times."
>
> *
>
> Francisco Cervantes Salazar, one of the earliest chroniclers of Mexico, gives evidence that the avocado was well known in the markets of Mexico City as early as 1554, which was very soon after the Conquest.

The Fuerte, a variety of avocado grown extensively in the United States and said to be a hybrid between the Mexican and Guatemalan races, originated at Atlixco in the State of Puebla. It was introduced into California in 1911.

The avocado is cultivated in practically every State in Mexico. Production has increased during recent years, amounting to 58,000 metric tons (about 64,000 short tons) in 1941 as compared with 35,000 tons (about 38,600 short tons) produced in 1932. Michoacán is the most important producing State, followed by Veracruz, Puebla, and Mexico. The tree grows on a wide range of soils, from the volcanic loams to heavy adobe. Good drainage, however, is essential regardless of soil texture.

Both tree and fruit are subject to the attacks of insect and fungus pests. Scale insects, seed weevils, and fruitfly are the most serious among the insects; scab, anthracnose, and leafspot are the most troublesome of the diseases. No attempt is made to control these pests through spraying.

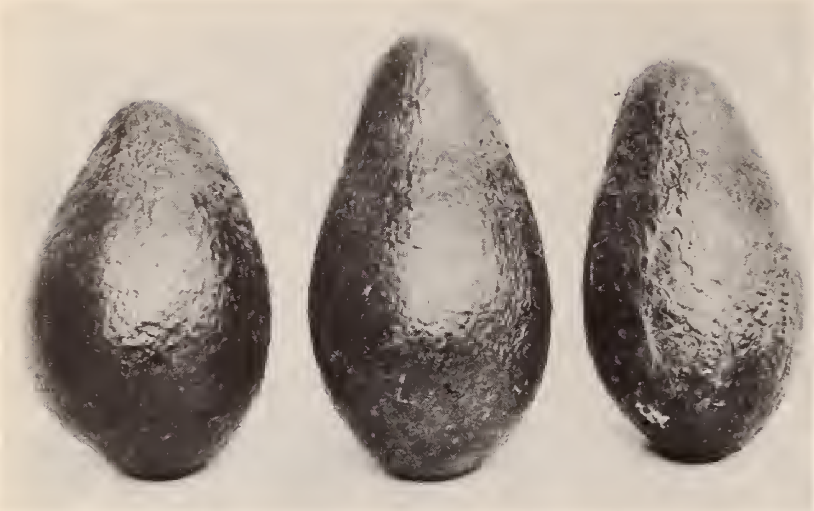


FIGURE 100.-Fuerte avocado. *(Courtesy of Dr. Wilson Popenoe)*

Papayas

The papaya is indigenous to the Americas, possibly to Mexico and Central America. It is grown to some extent in Florida, California, and Texas, but outside those areas it is little known. The fruit resembles a melon and is widely used in Mexico and all tropical countries to the south, largely as a breakfast or dessert fruit. It is sliced and served much as one would serve a honeydew melon, cantaloupe, or Spanish melon. The flavor is somewhat improved by squeezing the juice of a lime over it. The flesh is generally yellowish, pink, or reddish, but some papayas have little coloring. The fruits of highest quality are, in the opinion of the writers, a deep yellow or pinkish red. The fruit is often pickled, preserved, or used for juice. The plant and immature fruit contain a milky juice called papain, which has properties similar to pepsin. It is used extensively as a digestive agent and to tenderize meat and fowls. It contains an active enzyme and, when rubbed over a piece of tough steak, causes it to become tender. Old fowls are also made tender when wrapped in the leaves of the plant and allowed to remain several hours or overnight before cooking.

Some effort has been made to introduce papayas to the American public by popularizing the juice, but this does not take the place of a properly ripened fresh fruit. By special handling the papaya could be developed into a more important commercial fruit and its use extended to cover a much wider range of markets. Some additional breeding might be required to develop certain shipping qualities, and perhaps some further study should be made along lines of packing, containers, and transportation.

No official statistics are available on the annual production of papayas in Mexico. The plant is a rapid grower and produces fruit

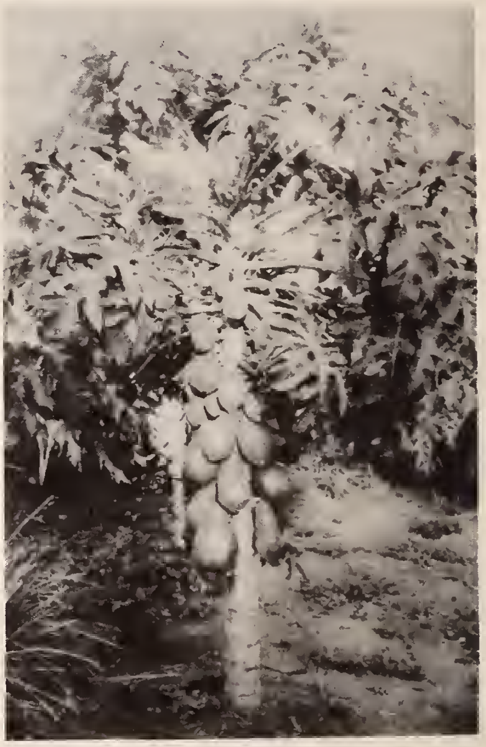


FIGURE 101.-Papaya tree with a cluster of fruit. *(Courtesy of Pan American Union)*

from 8 to 12 months after planting. Production, therefore, could easily be regulated to meet market demands.

Mangoes

The mango is one of the oldest of cultivated fruits, yet few North Americans have ever seen, much less tasted, it. While indigenous to southern Asia and the Malay Archipelago, it has been widely disseminated throughout the tropical regions of the world. It readily adapted itself to Mexico, where it has grown since early in the nineteenth century. The tree, which is an evergreen, reaches an enormous size. It produces thousands of blossoms, only a part of which develop into fruit. One writer describes it as follows (*4*):

> The fruit varies greatly in size and character. The smallest kinds are no larger than good-sized plums, while the largest are 4 or 5 pounds in weight. The form is oval, heart-shaped, kidney-shaped, round, or long and slender. The skin is smooth, thicker than that of a peach, commonly yellow on the surface but varying greatly in color. Some varieties are delicately colored, deep yellow or apricot with a crimson blush on one cheek; others are an unattractive green. . . . The color depends to a certain extent on the climate. . . . The aroma is often spicy and alluring, [often] indicative of the flavor of the fruit. The flesh is yellow or orange in color, juicy, often fibrous in seedlings and inferior budded varieties, but in the best sorts entirely free from fiber and of smooth melting texture. The seed is large and flattened, its tough, woody, husk, or outer covering inclosing a white kernel. The flavor of the mango has been likened to a combination of apricot and pineapple, yet it cannot be described accurately by any such comparison. It is rich and luscious in the best varieties, sweet, but with sufficient acidity and spiciness to prevent its cloying the palate.

Mangoes are found in many parts of Mexico, but more especially in the coastal plains, where climatic conditions are quite tropical and best suited to its needs. The preferred Manila mango is produced largely in the northern part of the State of Veracruz. The annual production is estimated at around 85,700 metric tons (about 94,500 short tons). The fruit ripens from May to July. The principal varieties are

TABLE 21.–*Number of trees and production of mangoes in Mexico, by principal States, 1937-41*

STATE	NUMBER OF TREES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
Durango	6	7	8	9	9	623	759	714	622	1,116
San Luis Potosí	24	24	44	42	42	1,774	1,322	1,949	3,036	3,058
Campeche . . .	30	33	33	30	31	2,111	2,922	3,221	7,381	4,656
Tabasco	33	28	36	39	37	4,297	2,465	3,431	3,969	3,603
Veracruz . . .	148	143	180	195	197	12,506	13,809	14,590	19,053	21,681
Yucatán	16	15	22	26	23	1,555	1,415	2,953	2,820	2,761
Baja California	4	5	5	5	5	340	457	554	726	1,120
Nayarit	13	13	11	9	8	1,241	1,341	1,257	784	848
Sinaloa	39	37	41	41	42	3,090	2,464	3,823	3,786	4,485
Colima	14	19	19	18	17	1,511	1,176	1,251	2,161	2,573
Chiapas	57	98	89	90	90	6,808	9,573	9,687	10,341	10,612
Guerrero . . .	47	56	56	60	57	4,295	5,141	5,941	7,194	7,168
Oaxaca	59	76	77	76	76	5,312	5,477	5,988	7,385	7,228
Guanajuato . .	3	4	15	14	13	333	481	1,052	1,468	1,656
Hidalgo	27	29	25	23	24	2,200	2,428	2,326	2,277	2,189
Jalisco	59	68	68	58	57	5,440	4,840	5,778	5,588	6,818
Mexico	14	11	11	10	10	1,448	806	1,074	1,041	1,058
Michoacán . . .	71	82	68	70	68	7,783	5,903	6,539	7,015	7,237
Morelos	31	24	29	26	30	3,484	2,121	3,065	3,312	3,257
Puebla	24	26	33	33	32	2,089	2,087	3,582	3,023	3,126
Others	10	11	11	12	12	1,067	1,017	1,083	1,535	1,881
Total	729	809	881	886	880	69,307	68,004	79,858	94,517	98,131

Compiled from official sources.

Criolla, or native seedlings, and the Manila, together with many seedlings of the Philippine type. The Manila variety is the best suited for commercial purposes because of its quality and its resistance to the Mexican fruitfly. Fresh mangoes are prohibited from entering the United States, but the canned product is very good and deserves a wider range.

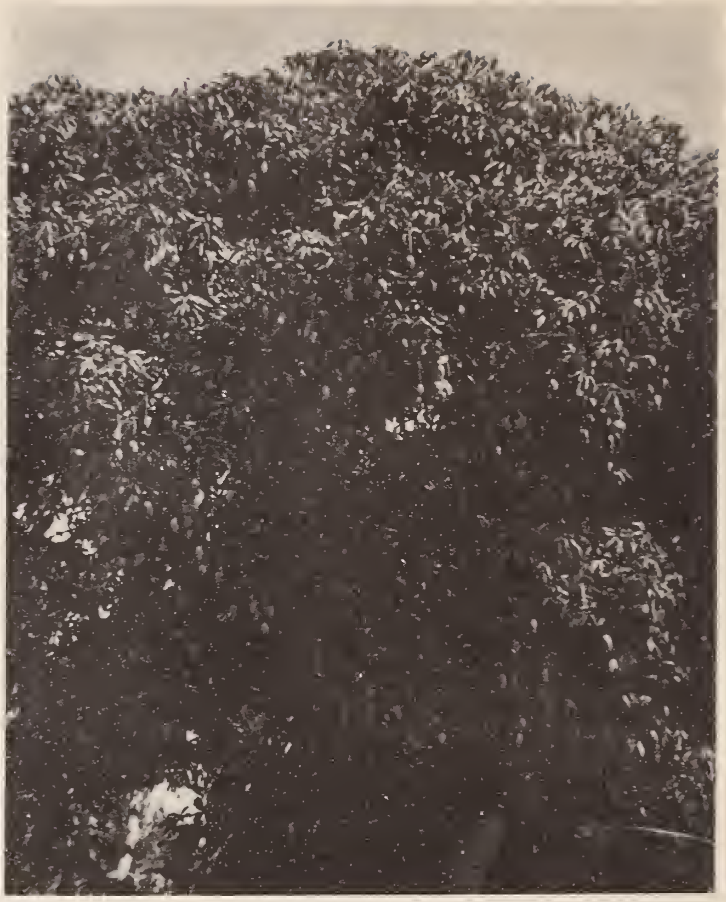


FIGURE 102.-A tree full of *mangoes de Manila*.

Sapotes

Other important fruits, native to Mexico and widely used, belong to the family Sapotaceae, genus *Sapote*. There are five distinct types or kinds of sapotes grown, each of which has its own peculiar characteristics. While belonging to the same family, they are quite dissimilar in appearance and character. These five types are as follows: *Zapote blanco*, or white sapote; *zapote amarillo*, or *zapote borracho*, the yellow sapote; *zapote negro*, or *zapote prieto*, meaning black; *chico zapote*, common name sapodilla, meaning small sapote; and *zapote (calocarpum mammosum*, more commonly known as mamey).

In the United States the sapodilla is perhaps the best known, because of the tree rather than its fruits. The bark of the sapodilla tree contains a milky latex, known as chicle, which is used as the basis for chewing gum. The fruits vary in form, size, shape, and color. The white, black, and *chico*, or small, sapotes are round; the yellow, long and conical; and the mamey, oval.

Chico zapote is perhaps the most abundant and best known of the sapodillas. The fruit is about the size of a Japanese persimmon and rather round. The skin is thin and when fully mature becomes rather delicate and rusty brown in color. The flesh is yellowish brown, sweet, and melting. The fruit contains several hard, black, flat seeds and is used primarily for dessert purposes.

Zapote negro is well named. When fully ripe the skin and flesh turn a dark brown, almost black, color. It is not especially attractive in appearance, but appearances are frequently deceiving. When fully ripe, it has a delicious flavor and ranks high as a dessert fruit. When prepared for this purpose, the soft mushy flesh is first removed with a spoon and then put through a colander, after which some

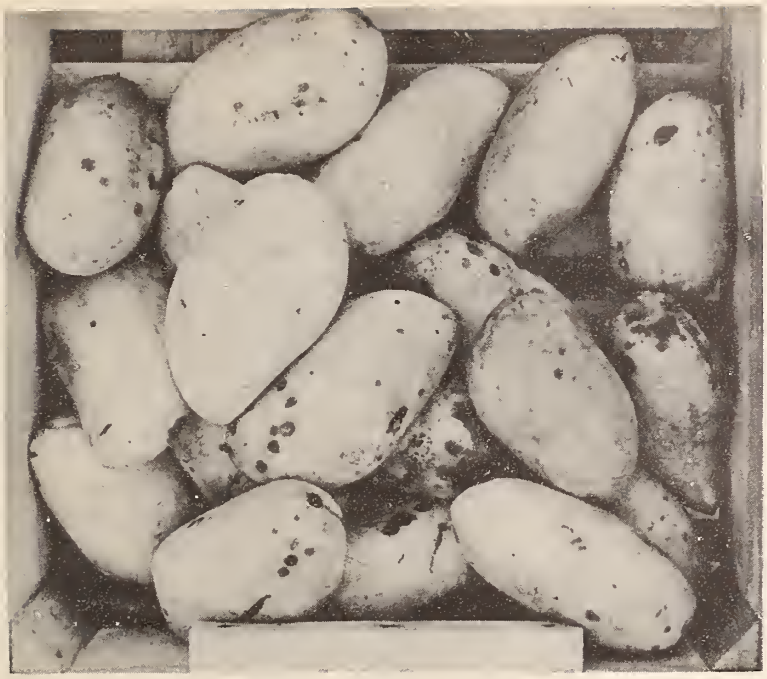


FIGURE 103.-Mexican mangoes.

orange juice or brandy is added to it. It may be served with or without whipped cream.

The yellow sapote is long and slender, curving somewhat toward its pointed apex. The immature fruit is green, but as the ripening process develops, it turns to an attractive orange-yellow color. The skin is thin and requires careful handling. It is rather widely grown in Mexico at elevations ranging from sea level to 6,000 feet. The fruit, which is eaten fresh, ripens during the winter months. Some excellent specimens were observed in the markets, especially in the more tropical parts of the country. It is more commonly known as *zapote borracho*, borracho meaning "drunk."

The *zapote blanco* is similar in size and shape to the black sapote (*zapote negro*) but the seeds are larger and white in color. The skin is thin; the flesh, yellowish and of soft melting texture. It is produced largely in the highlands at elevations of around 4,000 to 6,000 feet. It is eaten fresh and in the form of preserves.

The mamey (*sapote calocarpum mammosum*) is the largest of the family Sapotoceae. It is from 3 to 6 inches long, oval in shape, resembling a turkey egg. It is russet brown in color, with a thick skin that is woody and rough. The flesh is salmon red to reddish brown in color and

FIGURE 104.-Black sapotes ripened into prime condition for eating.

somewhat fibrous. When fully ripe it has a rich, sweet, pleasant flavor. By the unitiated, it would be regarded as a separate and distinct fruit, rather than as a member of the Sapotoceae family.

The sapotes, because of their susceptibility to fruitfly attacks, are prohibited from entering the United States. While they are used extensively in Mexico, no attempts have been made to develop an export outlet for them. The shipping and keeping qualities of the fruit are as yet undetermined. The mamey could undoubtedly be exported without much difficulty, but the others would certainly require special packing and handling because of their delicate skin and perishable nature.

TABLE 22.-*Number of trees and production of mameys in Mexico, by principal States, 1937-41*

STATE	NUMBER OF TREES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*
San Luis Potosí	13	13	13	13	10	2,509	2,796	2,909	2,822	2,452
Tabasco	10	10	10	10	10	2,432	2,600	2,654	2,358	2,835
Veracruz . . .	22	22	22	23	21	5,670	6,194	6,219	6,127	5,769
Yucatán	6	6	6	6	6	1,438	1,535	1,526	1,534	1,247
Chiapas	16	16	16	16	15	4,454	4,617	4,767	4,909	4,045
Guerrero . . .	8	8	8	8	9	2,305	2,415	2,528	2,165	2,206
Oaxaca	14	14	14	15	15	3,091	3,316	3,456	2,802	2,735
Hidalgo	3	5	5	5	5	1,039	1,102	1,145	1,082	1,109
Mexico	3	3	3	4	3	720	749	791	765	649
Michoacán . . .	6	6	6	6	6	1,139	1,220	1,235	1,077	1,052
Puebla	12	12	12	13	11	2,442	2,627	2,703	2,376	1,905
Others	11	11	11	12	13	2,651	2,857	2,988	2,797	2,421
Total	124	126	126	131	124	29,890	32,028	32,921	30,814	28,425

Compiled from official sources.

Cherimoyas

The cherimoya (*Annona cherimola*) has been described as the masterpiece of nature, and it is said that Mark Twain characterized it (*4*) as "deliciousness itself." The fruit is indigenous to tropical America. Its native home is somewhat in doubt. Some authorities suggest Ecuador, some Peru, whereas others say some Central American country. At any rate it is a distinct contribution of the Western Hemisphere. It goes by many names, including chirimoya, cherimolier, chirimuya, annona, and custard apple. In London and in other English markets, it is known as custard apple.

The cherimoya has been grown in Mexico for many years; in fact, for so long a time that some people claim it might even be

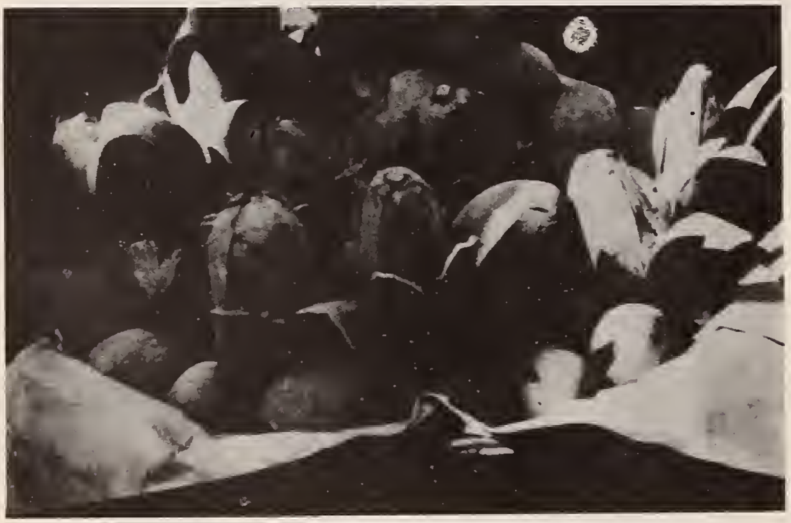


FIGURE 105.-The mamey.

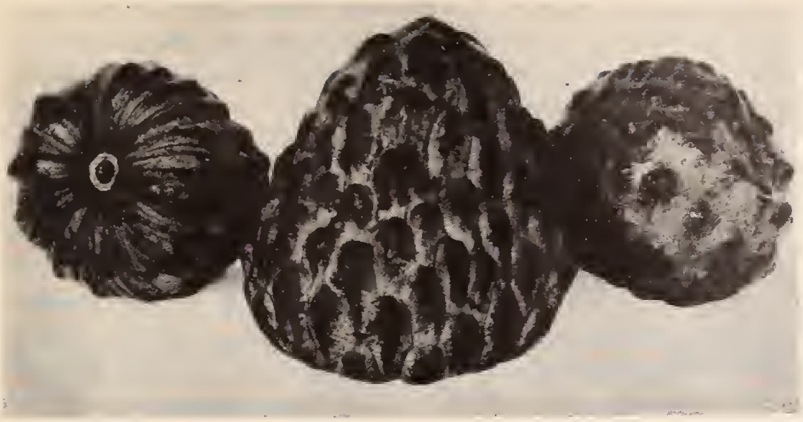


FIGURE 106.-The cherimoya.

indigenous to that country. Popenoe, however, states (*4*): "From its habitat in South America, the cherimoya early spread northward to Mexico; much later it passed into the West Indies, the southern part of South America, and across the seas to the islands near the African coast, to the Mediterranean region, and to India, Polynesia and Africa."

In Mexico the fruit is produced at elevations ranging from 3,000 to 6,000 feet. The fruit is popular throughout Mexico and was observed in many markets, including small towns in the more remote parts of the country.

It is somewhat irregular in form, but the most common type is heart-shaped. The size also varies considerably; most specimens observed in the markets were about as large as an orange. It is light green in color, although after being on the market for several days it turns rather dark. The skin is thin and delicate and requires careful handling. It has not been commercialized to any great extent, although it has been successfully transported from South Africa, the Portuguese possessions, and other distant points to the United Kingdom.

Sweet Granadillas

The granadilla, or passionfruit, is widely grown throughout Mexico and the Central Americas. The purple species is cultivated quite extensively in South Africa, Australia, and the Mediterranean Basin and under normal conditions is shipped to the United Kingdom and continental European markets. The sweet granadilla (*Passiflora ligularis*) is rather widely distributed in Mexico and is especially popular among the Indians. It is about the size and shape of an egg, reddish orange in color,

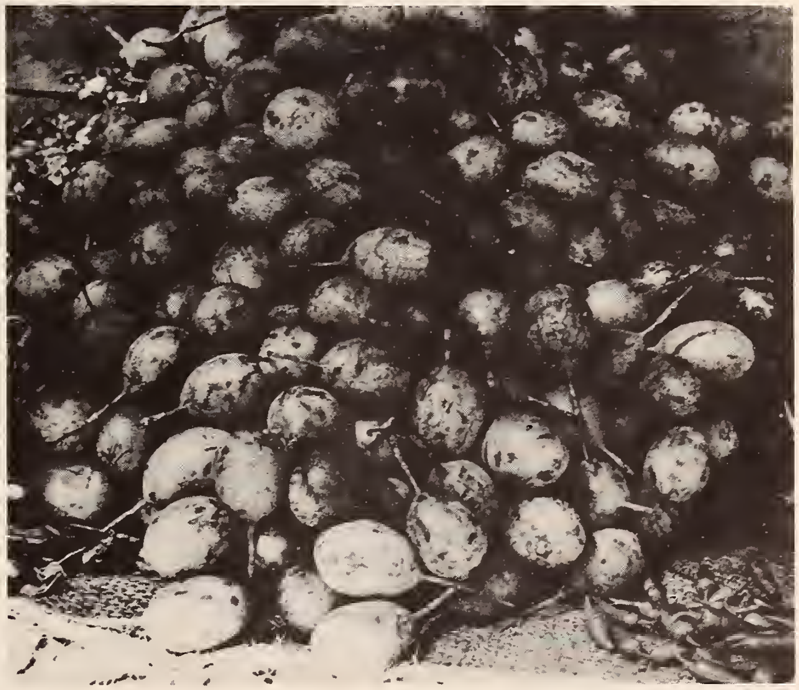


FIGURE 107.-Granadillas.

flecked occasionally with yellowish-green spots. The skin is shell-like and brittle. Within this shell are numerous small seeds, each of which is surrounded by a whitish juicy pulp. The shell is quite tough and is therefore quite capable of withstanding the rather tough treatment to which it is frequently subjected.

DECIDUOUS FRUITS

Although southern latitudes suggest tropical conditions, a large part of the countries lying between parallels 30° N. and 30° S. have a climate which is more temperate than tropical, or even subtropical in nature. In Mexico, as in other Central and South American countries, the climate is influenced to a great extent by mountain ranges that rise to great heights. With its extremely mountainous profile, Mexico has, despite tropical conditions in many parts, large areas where climatic conditions are definitely temperate. Temperate conditions, however, do not necessarily mean that the area is adapted to the growing of Temperate Zone crops. There may be other obstacles, such as a rugged mountainous terrain or a deficient or irregular supply of moisture. Vegetation grows rapidly and luxuriantly in the hot, humid, tropical lowlands, but the rate of growth and maturity of the crops is slowed down perceptibly in the higher elevations. Near the bases of snow-capped mountains that rise to heights of over 18,000 feet, at elevations of around 2,000 to 4,000 feet, tropical plants, such as bananas, coconuts, pineapples, mangoes, avocados, and oranges flourish; farther up the slopes, or in the high mountain valleys, at elevations of from 6,000 to 10,000 feet, the climate is adapted to the production of apples, pears, grapes, plums, and other fruits familiar to inhabitants of a temperate clime.

Since Mexico lies south of parallel 30° and a large part of the country is nonarable, one is surprised to find deciduous fruits scattered over a wide area. (For the location, distribution, and size of the deciduous-fruit industry, see tables 23, 24, and 25.)

The production of deciduous fruit in Mexico can scarcely be compared with the commercial industries that have been developed in such countries as the United States, Argentina, Canada, Australia, and South Africa. No wide valleys or large areas in Mexico are devoted almost exclusively to apple or pear growing, and intensified fruit growing is not regarded as a highly specialized business. There are a few large commercial holdings, but the plantings for the most part are small and scattered. Cultural practices are primitive and reduced to a minimum. The deciduous-fruit industry consists of a large number of trees, broken up into very small lots, and scattered over thousands of farms and dooryards. In some instances, the volume of fruit that is credited to a certain State or area suggests a rather sizable industry, but to locate the origin or source of this supply is a somewhat difficult undertaking. The output invariably represents harvests from a few trees here and a few trees there, which in the aggregate add up to an appreciable volume.

Apples, for example, grow in 24 States, but the bulk of the production is concentrated in Puebla, Hidalgo, Chihuahua, Coahuila, Veracruz, and Michoacán. These 6 States account for 70 percent of the total. Peaches are also produced over a rather wide area, but most of the crop is centered in 10 States, representing 77 percent of the total. The same is more or less true for other fruits, such as pears, plums, quinces, etc.

The production of deciduous fruit is for domestic use only, with supplies still short of meeting normal market requirements. Attempts to expand the industry will be directed toward building up a state of self-sufficiency rather than toward developing a possible export trade. The chances of accomplishing either in the near future are rather slim. The limited amount of arable land, weather hazards, inadequate capital, and lack of knowledge will make expansion a slow process. Exports, if attempted, would in all probability result in failure because of the varieties produced and the poor quality and presentation of the fruit.

Deciduous fruits have been grown in Mexico for many years, but little progress has been made in the selection of varieties or in cultural practices. Commercial orcharding in its modern sense is virtually unknown. A few individuals have introduced nursery stock from the United States and have set out the trees in approved fashion. This has stimulated a certain amount of local interest but has not been very far reaching.

Most of the old plantings consist of seedlings of one kind or another. Nearly all the orchards are small, badly mixed up, and somewhat like neglected farm orchards. They usually consist of a general mixture of fruit trees, such as apple, pear, plum, a few peach, and quince. Plantings are made under all sorts of conditions, depending upon the locality and the topography of the country. Some orchards are located on high mountain plateaus where the land is level, some in the valleys, and others high up on steep hillsides and mountain slopes, where they must be cultivated by hand. In some areas there is sufficient rainfall to mature the crop, and in others the trees must depend solely upon irrigation. Some districts offer possibilities for limited expansion; in others, any increase is restricted by the scarcity of arable land and a deficiency of water.

The following varieties of deciduous fruits are offered and recommended by nurseries in Mexico. They are not widely planted, however.

APPLES

Delicious
Reinette Pippin
Stayman
Golden Delicious
Yellow Newtown
San Angel

PEARS

Anjou
Douglas
Garber
Le Conte
Kieffer

QUINCE

Finos

PLUMS

America
Burbank
Endicott
Gold Japan
Gaviota
Methley
Red June
Satsuma
Santa Rosa
Wickson

PEACHES

Crawford
Crosby
Elberta
Eureka
Greensboro
Henrietta
J. H. Hale
Mamie Ross
Orange Cling

CHERRIES

Early Richmond
Reine Hortense
Bing
Black Tartarian

TABLE GRAPES

White Amber
Emperor
Malaga
Muscat of Alexandria
Rose of Peru
Thompson Seedless
Flame Tokay

PRINCIPAL PRODUCING AREAS

Puebla

Puebla is one of the richest agricultural States because of its relatively high percentage of arable land. It leads in the production of apples with a total of 119,008 trees, 36,190 listed as *manzanas* and 82,818 as *perones*. The orchards are mostly concentrated within an area a few miles west of the city of Puebla, which is the capital of the State and the fourth largest city in Mexico. The plantings are on the flat level land of the plateau, or high mountain valley, at an elevation of about 8,000 feet above sea level. The valley floor, however, is broken up by large mounds caused by volcanic eruptions. The valley is also flanked by mountains that rise to heights of over 17,000 feet. The rainfall in this area averages around 31 inches per year. The soil is volcanic, light in color, and of very fine texture. In some instances, it has almost the same consistency as flour and shifts back and forth with the action of the wind.

The older orchards in this area are pretty much of a conglomeration. Apples, pears, and plums are planted together without any thought for order or alignment. The trees are closely spaced and any pruning done is usually from the ground up. The older plantings have an unkempt appearance and resemble old neglected farm orchards. The newer plantings, however, are of a different type. They are laid out in straight rows and show some evidence of commercial orchard practices, but the district as a whole seems to have no established system of planting. Each orchard apparently expresses the individual ideas of its owner. The rows vary from 25 to 50 feet in width, and the trees are spaced from 8 to 10 feet apart in the row. The bushy, compact trees appear dwarfed and stunted, reflecting the minimum of care. The land between tree rows is planted for farm crops and intensely cultivated; in fact, annual cash crops, such as corn and beans, receive first consideration, and the fruit trees are actually secondary to them.

During the past 4 to 6 years the planting of both apples and pears, especially apples, has been rather heavy in the Puebla area, particularly along the highway between Puebla and Mexico City.

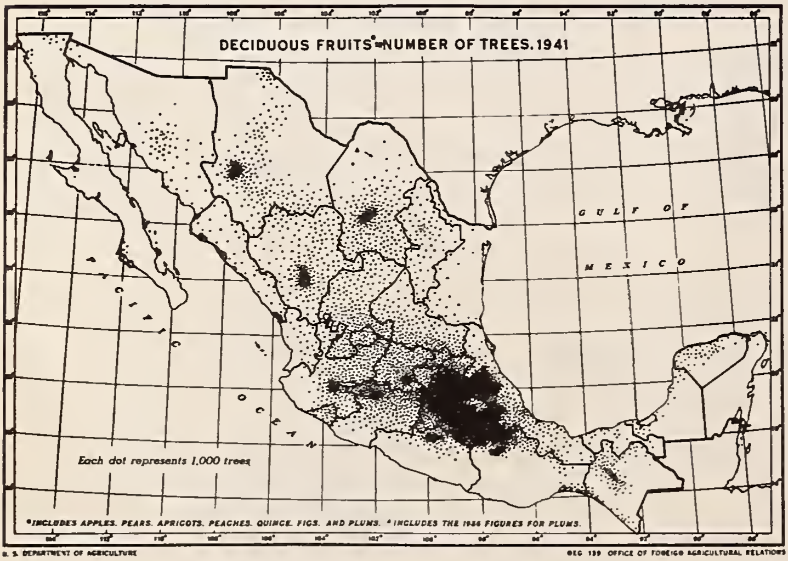

DECIDUOUS FRUITS*-NUMBER OF TREES. 1941
GULF OF MEXICO
OCEAN
Each dot represents 1,000 trees
*INCLUDES APPLES, PEARS, APRICOTS, PEACHES, QUINCE, FIGS, AND PLUMS. ^INCLUDES THE 1936 FIGURES FOR PLUMS.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 139 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 108.-Distribution of deciduous fruits in Mexico.

Teziutlán

Another important deciduous area is located around Teziutlán, which is about 100 miles northeast of Puebla. Teziutlán is in the State of Puebla but close to the Veracruz state line. It is an extremely mountainous region; and, although the altitude is only around 6,500 feet, it has a temperate climate and a long growing season.

The terrain is rough and broken; though crops are extensively cultivated, many of the fields are located on steep mountain slopes, which practically prohibit the use of work animals or farm machinery. Estimates indicate that about a million fruit trees are planted in this area, consisting largely of plums, apples, pears, and a few peaches. The amount of tillable land is scarce; in fact, some areas now under cultivation do not appear to be well adapted to farming purposes.

One large landowner recently established an orchard with 100,000 trees that were imported from the United States. This planting is, for the most part, in a valley and on hillsides, where the land can be worked with animals and machinery. The fruit from this area, however, though it adds up to a considerable volume, is said to be inferior in quality. The stone fruits, especially, are small, watery, insipid, and lacking in flavor. The district is also at a disadvantage from the standpoint of transportation; it is served by a branch railway, but the roads are poor, almost impassable during bad weather.

Coahuila

The areas devoted to the cultivation of deciduous fruits in the State of Coahuila are quite different from the fruit-growing section of Teziutlán, but in a land of sharp contrasts this is to be expected. Coahuila is an arid country with 9 months of dry and 3 months of wet weather. It bears a close resemblance to parts of western Arizona and the section of central Washington in the vicinity of the Grand Coulee Dam. The rainy season, which extends from June through August, is not favorable for maturing the fruit crop and interferes with harvesting operations. Most of the cultivated areas are on a high plateau surrounded by ranges of mountains. The fruit lands are mainly in the lower elevations, 5,000 to 5,500 feet, and can, therefore, be more readily irrigated from the high-line ditches that

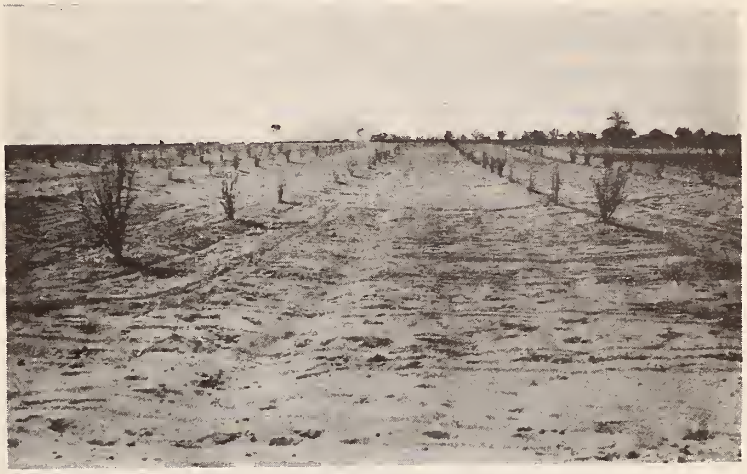


FIGURE 109.-A young apple planting in the fine volcanic-ash soil near Puebla.

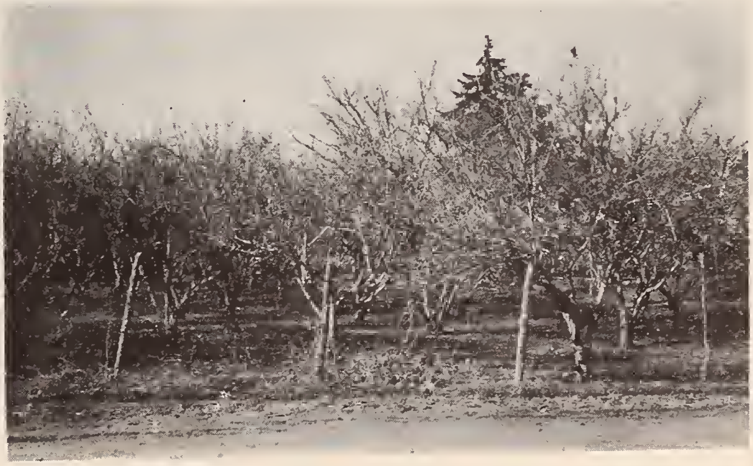


FIGURE 110.-An older planting showing unkempt appearance.

are supplied with water from mountain springs. Climatic conditions are not especially favorable for fruit growing. Weather hazards, such as heavy freezes, severe hailstorms, and seasonal rains before and during the harvest period, are common to this region. The soils are predominantly alluvial, with a high calcium content. They are mostly deep, well-drained, and have a deep-lying rock and gravel base.

Apples, pears, quinces, plums, and grapes are the principal fruits grown. Apple production consists almost entirely of perones, which are shipped to the larger markets in Mexico. These trees grow satisfactorily as a result of established cultural practices, and seem to be better adapted to the region than some of the others.

Quinces are produced on a rather extensive scale and are used principally for the manufacture of quince paste. As in most Latin American countries, this product is very popular. It is prepared by boiling the fruit with sugar, after which it is poured into molds and placed in the sun to set and harden. The trees are given the minimum of care and are usually mixed in with other fruits or set out in hedgerows. Some severe cases of crown gall were observed. Fire-blight also made its appearance in the district about 10 to 12 years ago, but it causes less damage than one would expect in the absence of control measures.

Large blocks of pear trees have been set out during recent years. The trees have made good growth, but many of them have been killed back by fire blight. Since no effort has been made to control the blight, it is spreading rapidly and threatens the pear industry with extinction. Some of the orchards have been interplanted with grapes, in order that the pear trees may be removed if the blight becomes more serious. The outlook for pear growing is not bright, and it is doubtful if the industry ever reaches commercial importance.

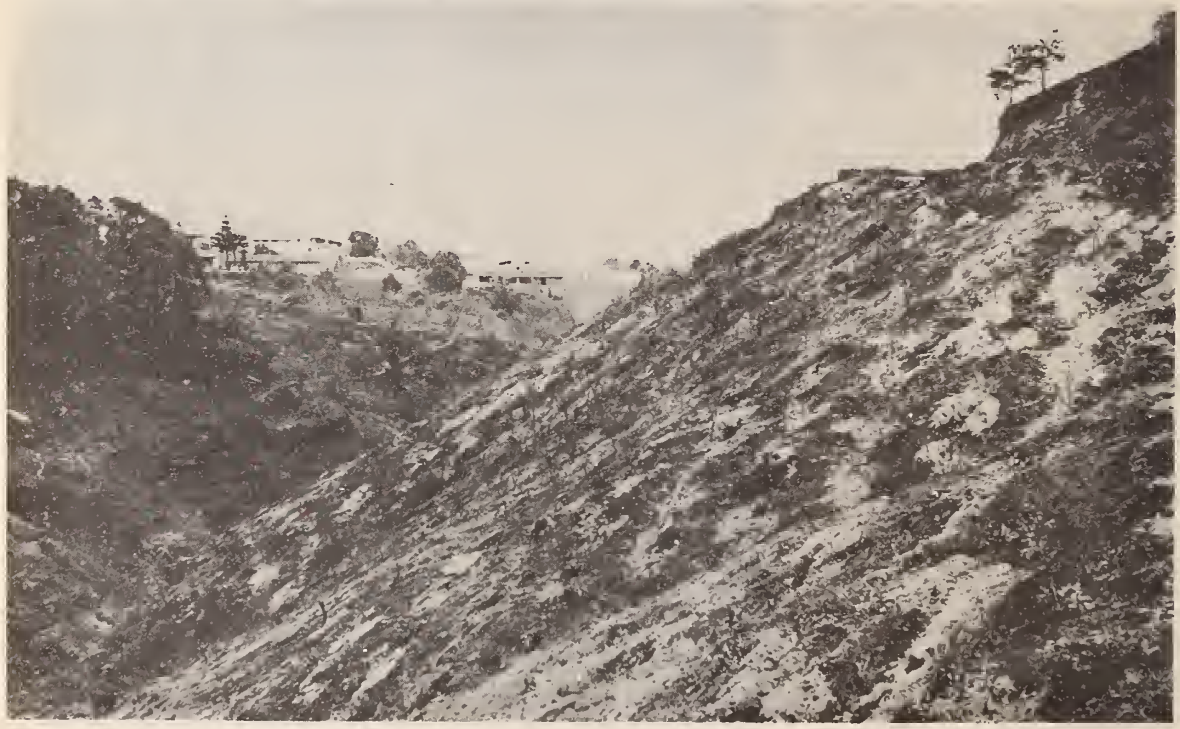


FIGURE 111.-Steep hillside planting of plum trees at Tezuitlán, Puebla. This type of planting is characteristic of many of the orchards in this area.

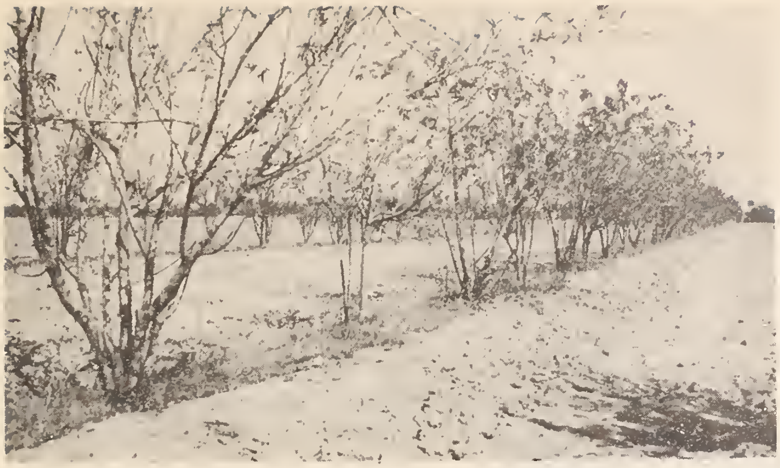


FIGURE 112.-Planting system commonly employed in the Puebla area.

Plums are produced in small quantities. A few orchards have been established in recent years, but they are not very promising. In most instances, there is distinct evidence of lack of congeniality between stock and cion. The trees are undeveloped and make a slow spindling growth. The outlook for the plum industry is not bright.

Efforts are being made to stimulate an interest in grape growing in order to establish this industry on a commercial basis. The weather hazards, common to this district, are, however, definitely against any great success along this line. The grapes produced in this area are reported to have a low sugar content and are of mediocre quality. The vines are planted, spaced from 4 to 7 feet apart, in rows about 6 feet apart. They are trained on 2-wire trellises and pruned according to the cane-and-spur system. Although they are making a strong vigorous growth, the future of this industry also is not promising.

Parras

Parras, which is about 100 miles west of Saltillo, is in the center of an interesting and successful grape-growing district. The industry, said to have been started in 1626 by the early Spanish settlers, soon achieved success. A winery was established, and during the period of the Spanish colonial administration a monopoly was granted for the manufacture of sacramental wines. The wine was transported to Mexico City, a distance of 600 miles, in large casks drawn by oxen. The journey required about 2 months and was made over a road that went through Zacatecas.

FIGURE 113.-Young orchard at Teziutlán owned by General Maximino Ávila Comacho.

Parras has an elevation of about 5,000 feet and is hemmed in by mountains from 1,000 to 3,000 feet high. The uncultivated areas support the usual desert chaparral, such as cactus, mesquite, yucca, and huisache. The country, much like Arizona, is quite productive where water is obtainable despite large areas of wasteland.

The grape district is irrigated, but cultivation is restricted by the limited water supply, which originates in the springs that flow from the nearby mountains and which is diverted into canals dug along the steep mountain slopes. In some instances tunnels, bored through the mountain, carry the water to the valley below. The soil is alluvial, deep, and quite fertile. It has a heavy calcium content, but where sufficient water is available it is capable of producing splendid crops.

Although primarily a wine-grape district, table grapes are also grown. The vines make a good growth, but they are spaced very closely together. From 2,000 to 2,500 vines are planted to the hectare (800 to 1,000 per acre). Approximately 500 hectares (1,250 acres) are devoted to grapes in this small valley.

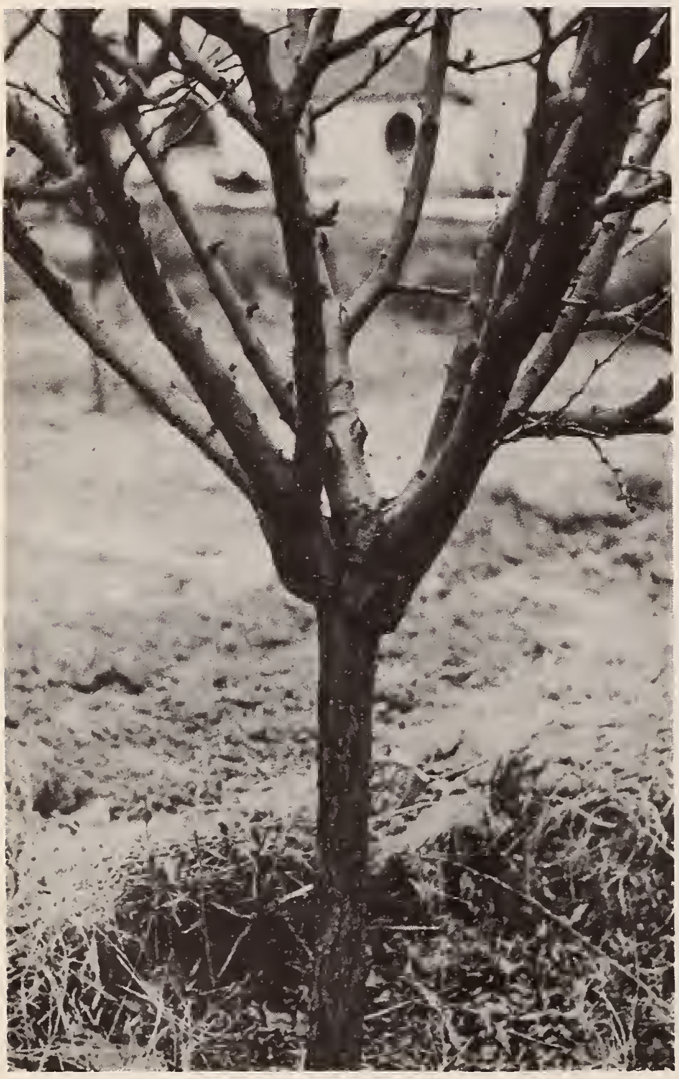


FIGURE 114.-Plum tree exhibiting incompatability of stock and cion. Saltillo, Coahuila.

The climate is generally favorable, but occasional frosts cause considerable damage. In the spring of 1940 frosts destroyed about 50 percent of the crop. Some smudging is done but generally not enough to have any material effect upon the crop.

The following varieties of wine grapes are produced: Muscat (red and white), Alicante, Prune de Cazouls, and various old Spanish varieties the identities of which are unknown. Table grapes include Alphonse Lavallee, Cornichon, Emperor, Sultanina (Thompson Seedless), and Flame Tokay.

Small plantings predominate in the district, but there are several large holdings. The range is from 4 to 250 hectares (10 to 618 acres). The annual output of wine averages around 2 million liters (about 500,000 gallons), to which one producer contributes approximately half. The output is sold entirely within the country. The vintage practices followed are the same as those used in Spain and France. Prior to the war Mexico imported annually up to 4 million liters (about 1 million gallons) of wine from Spain and 2 million liters (500,000 gallons) from France.

Unless the present water supply is increased, the industry cannot be greatly expanded. The vineyards are somewhat scattered because of the distribution of water, and already some of those in out-of-the-way places are difficult to supply. No increase in acreage is therefore anticipated.

PRINCIPAL CROPS

Apples

The apple most commonly grown throughout Mexico is known as the *peron* and is regarded as a type quite separate and distinct from the *manzana*, which is the Spanish word for apple. In other Latin American countries, manzana is used to describe all apples, but in Mexico only red varieties of apples are classified by this term, and all green and yellow varieties are referred to as peron. Even in the official government statistics, these two types are broken down into separate groups.

The peron, which is similar in many respects to the cider apples produced in central and southwestern Europe, is said to have been introduced from Spain by the Franciscan monks early in the sixteenth century. Historical recordings are rather vague and meager, but the monks appear to have played a role similar to the one accredited to Johnny Appleseed. Early in the history of Mexico the Franciscan monks not only founded cities throughout the country, but they introduced to the New World many agricultural and horticultural crops long cultivated in Europe.

A planting of perones is said to have been established first at Saltillo in 1586, about the time the town was founded. It is now the capital of Coahuila, which State at one time included the present State of Texas. From this planting, perones spread to other parts of the country. They would be difficult to sell in most other countries but are looked upon with favor in Mexico and are found in all markets.

The peron tree is upright, rather small, compact, and bushy; in fact, it has much the same appearance as the cider-apple trees in parts of Europe. The fruits vary in size and shape, but most of them are small obovate, and flattened at the calyx. The skin is rather tough, yellow, and sometimes rather heavily blushed. The flesh is white, firm, and rather fine in texture. It bears some resemblance to the Chenango, Ortley, or Black Gilliflower in shape but is yellow in color and much smaller in size. It is more of a late-fall and early winter variety, but it is marketed from July through March. Harvesting usually commences before the fruit is mature, and it is available on the market long after its normal marketing period. Not an especially attractive apple at best, it has even less appeal late in the season, when it becomes withered, leathery, spent, and

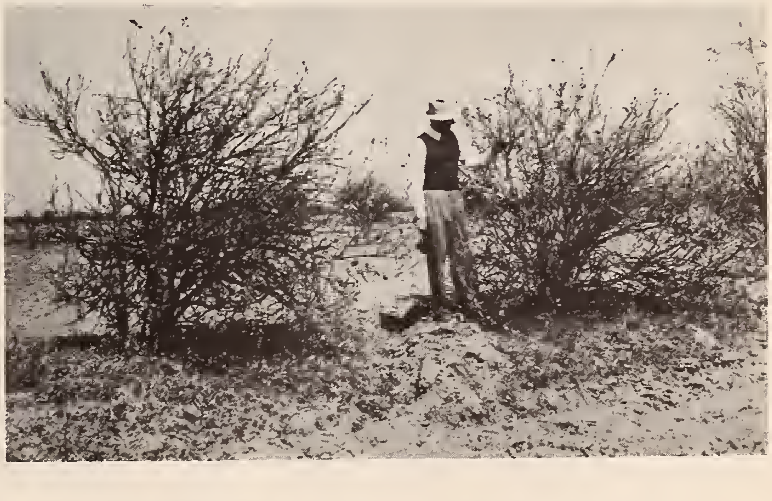


FIGURE 115.-An orchard of perones near Puebla.

TABLE 23.- *Number of trees and production of selected fruits in Mexico, by principal States, 1937-41*

STATE	NUMBER OF TREES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
APPLES										
Coahuila	42	42	44	40	46	2,399	2,407	2,331	4,113	4,729
Chihuahua	72	67	64	71	78	2,116	1,710	2,668	2,878	4,610
Durango	80	72	116	120	122	5,779	5,461	6,614	6,762	7,319
Zacatecas	35	50	45	49	46	1,247	1,339	2,389	4,338	3,952
Veracruz	11	15	23	23	26	401	450	1,283	1,337	1,412
Distrito Federal	16	21	27	27	26	496	713	1,102	1,145	1,168
Guanajuato	14	24	19	25	26	674	952	1,097	1,263	997
Hidalgo	70	69	83	85	85	2,949	3,986	2,920	2,652	3,195
Jalisco	11	12	20	21	20	551	387	925	1,271	1,211
Mexico	31	32	43	45	40	1,229	1,292	2,938	1,787	1,521
Michoacan	18	17	20	25	23	960	887	1,120	2,080	2,256
Puebla	135	160	168	188	206	5,693	6,581	8,696	10,752	11,796
Others	54	72	63	71	85	2,009	2,468	2,700	3,981	4,342
Total	589	653	735	790	829	26,503	28,633	36,783	44,359	48,508
PEARS										
Chihuahua	16	16	23	25	26	599	604	1,086	1,251	1,334
Zacatecas	40	46	38	42	40	1,382	1,529	1,249	1,322	1,754
Hidalgo	2	6	15	17	19	60	104	1,166	540	952
Mexico	31	29	28	30	28	997	872	868	912	1,152
Michoacan	15	20	26	25	26	528	1,035	1,122	1,096	1,187
Puebla	18	28	31	34	33	643	836	1,134	1,281	1,673
Others	107	109	120	128	128	3,698	3,824	4,417	4,830	4,786
Total	229	254	281	301	300	7,907	8,804	11,042	11,232	12,838
PEACHES										
Coahuila	29	32	32	36	49	1,071	1,094	1,508	2,129	3,789
Chihuahua	75	68	71	73	75	2,695	2,554	2,935	2,692	3,779
Durango	46	45	44	48	47	1,462	2,027	1,892	1,532	1,473
Nuevo León	23	22	18	23	26	474	481	709	780	1,183
San Luis Potosi	29	33	40	43	63	533	881	1,249	1,025	1,680
Zacatecas	49	46	37	48	53	1,329	1,238	845	1,849	2,180
Veracruz	40	43	39	42	42	1,069	1,358	1,186	1,008	919
Sonora	23	29	27	28	23	679	736	1,192	939	1,049
Chiapas	27	30	28	29	35	646	1,013	1,123	879	1,168
Oaxaca	34	36	30	35	43	955	984	939	953	1,235
Guanajuato	78	78	76	85	86	2,320	2,749	3,332	2,949	2,152
Hidalgo	63	99	79	92	112	1,468	2,343	2,860	2,464	2,739
Jalisco	84	105	105	112	108	2,315	3,907	4,670	3,685	3,656
Mexico	157	182	186	186	185	2,800	5,551	7,452	3,875	3,826
Michoacan	110	98	91	117	162	2,672	2,813	3,602	4,284	8,832
Morelos	15	17	16	16	19	787	819	1,062	546	759
Puebla	122	128	111	146	157	3,004	3,465	3,769	4,077	4,099
Tlaxcala	10	12	10	13	16	699	799	915	644	1,267
Others	66	77	59	58	84	1,617	2,144	2,324	2,038	2,286
Total	1,080	1,180	1,099	1,230	1,385	28,595	36,956	43,564	38,348	48,071
QUINCES										
Coahuila	31	34	56	63	53	1,412	1,383	1,156	1,543	3,588
Chihuahua	31	34	19	27	30	726	775	701	1,184	1,313
Durango	35	35	37	34	32	879	593	823	957	1,922
Zacatecas	35	40	43	44	42	1,070	938	1,195	1,527	1,226
Sonora	16	17	12	14	14	671	626	466	759	1,138
Guanajuato	39	28	32	35	38	1,165	894	1,170	1,359	1,312
Jalisco	31	41	37	36	36	1,055	1,404	1,219	1,004	1,014
Puebla	18	25	27	32	30	696	855	745	949	1,060
Others	83	82	78	92	101	2,748	2,790	2,782	3,365	3,711
Total	319	336	341	377	376	10,422	10,258	10,257	12,647	16,284

Compiled from official sources.

lifeless. Under proper storage conditions, however, the fruit could probably be kept even longer or at least be offered in more merchantable condition.

The best apple-producing area in Mexico is said to be in Chihuahua. A Mormon colony was established at Casa Grande, and one of its undertakings was to supply the market with good-quality fruit of preferred varieties, such as King David, Jonathan, Delicious, Arkansas Black, and Winesap. When the trees came into production, a firm in Mexico City undertook to teach the producers how to prepare and pack their product for the market. The standard Northwest box was adopted, and each year a member of the firm spent several weeks in the district supervising and instructing the growers in the art of grading and packing. At first there was considerable interest, and the growers made a conscientious effort to put up a good pack; but competition between buyers developed, and the growers soon learned that they could dispose of their crop without worrying much about quality and presentation. The original idea behind this effort was to place Chihuahua apples on a competitive basis with imported supplies from the United States. Owing to the wide disparity, however, between the laid-down cost of domestic apples versus imported apples, competition was not sufficiently keen to justify the extra effort. In other words, Chihuahua apples could be purchased for 8 pesos ($1.65) per box and sold for 12 ($2.47), whereas United States apples that cost around 22 ($4.53) were sold at from 24 to 25 pesos ($4.94 to $5.14) per 44-pound box. Dealers could realize a quicker and easier profit from Mexican apples than was possible from the United States fruit; consequently, it was only natural that they should turn to the home-grown supply.

Pears

The production of pears is not important in Mexico. They are grown along with apples, and no attempt has been made to develop a separate industry. In general, only the hardiest varieties, such as Kieffer and Garber, are grown. These stand up best under Mexican conditions. Some Bartletts are produced in the Mormon colony in Chihuahua, which are well received in the Mexican market. The size is small, but the flavor is reputed to be very good. They appear on the market during the month of August.

TABLE 24-*Number of trees and production of plums in Mexico, by principal States, 1932-36*[1]

STATE	NUMBER OF TREES					PRODUCTION				
	1932	1933	1934	1935	1936	1932	1933	1934	1935	1936
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
San Luis Potosí	42	40	41	47	47	2,061	1,386	1,326	1,655	1,734
Campeche . . .	22	22	19	16	19	1,240	1,260	879	620	816
Veracruz . . .	95	98	102	102	102	2,901	3,322	3,372	3,944	3,812
Yucatán	43	42	45	41	42	2,256	2,169	2,295	2,051	2,085
Sinaloa	17	19	20	25	27	703	757	897	1,077	1,147
Chiapas	54	56	58	58	59	1,875	1,821	2,111	2,016	2,040
Guerrero . . .	83	81	84	85	88	3,194	3,430	3,469	3,223	3,295
Oaxaca	44	42	44	45	48	1,202	1,531	1,658	1,684	1,778
Jalisco	44	41	40	48	50	2,130	1,693	1,554	2,001	2,027
Michoacan . . .	33	32	35	33	33	1,149	1,195	1,319	1,260	1,355
Morelos	29	27	29	30	31	1,487	1,412	1,415	1,335	1,402
Puebla	100	107	115	126	124	2,510	2,284	2,705	3,823	3,679
Others	170	166	169	157	168	6,150	5,890	5,505	5,507	5,424
Total	776	773	801	813	838	28,858	28,150	28,505	30,196	30,594

[1] Comparable data for later years not available.

Compiled from official sources.

Apricots

Conditions in Mexico are not considered suitable for the growing of apricots. The few that are produced are said to be small in size and inferior in quality. The trees bloom very early and are frequently killed by frosts. An average crop is obtained only about once in 5 years.

Peaches

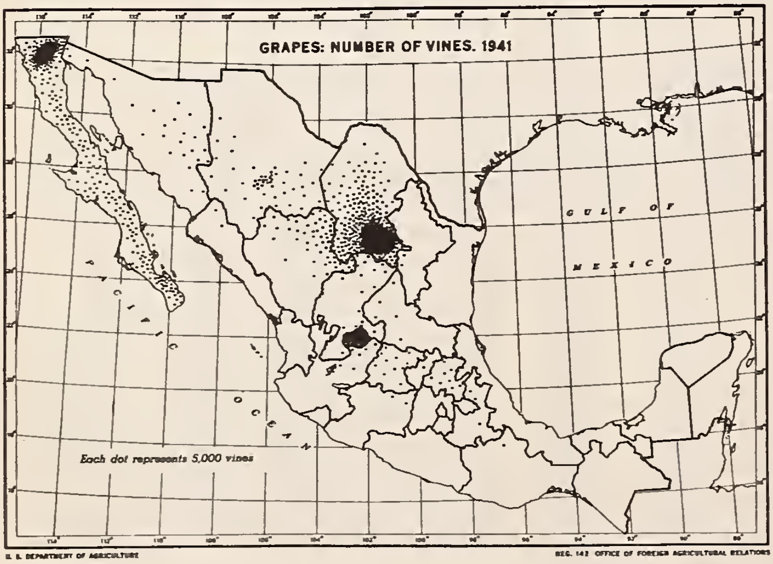
Mexican peaches consist for the most part of seedlings. Although budded stock of standard United States varieties has been introduced from time to time, it has been allowed to deteriorate and run out. The seedling trees produce small fruit, which is said to be rather insipid and lacking in quality. There are no commercial orchards of any consequence; and, although the total tonnage indicates an industry of some importance, it is produced by a large number of trees scattered about in fields and dooryards.

Plums

According to official statistics, Mexico has about 850,000 plum trees with an average production of 28,000 metric tons. The States of Veracruz, Guerrero, Chiapas, and Puebla account for the greater part of the crop. Plums, however, are a small item in the market. Spring frosts constitute the greatest hazard in connection with the raising of plums and frequently destroy the blossoms, which appear early in the year. A good crop usually occurs once in 3 or 4 years. Offerings first appear on the market between April 15 and May 1 and continue for about 2 months. A green plum of unknown variety is said to make its appearance first and is followed by Red June, Santa Rosa, Methley, Wickson, etc. Many of the trees are seedlings of unknown parentage, and most Mexican plums are said to have a low sugar content and a high percentage of water.

Grapes

The production of grapes is confined to those States where more or less arid conditions prevail, such as Coahuila, Baja California, Chihuahua, Hidalgo, etc. Climatic conditions, however, are not altogether suited to successful grape culture. The areas in which grapes are produced have a long dry period, but rains occur during the late growing and harvesting season, which, from the standpoint of quality, shipping, and marketing, is a most unfortunate situation. The cloudy weather has an adverse effect upon the manufacture of sugar, and the rains cause splitting and decay and greatly


GRAPES: NUMBER OF VINES. 1941
GULF OF MEXICO
Each dot represents 5,000 vines

U. S. DEPARTMENT OF AGRICULTURE NEG. 142 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

FIGURE 116.-Distribution of grapes in Mexico.

reduce shipping and marketing qualities. The marketing season for domestic grapes extends from the last of May through August. Although the demand for grapes is good, the public prefers imported to home-grown supplies because of the poor quality of the latter. The cost, however, for imported fruit is so high that consumption is limited.

TABLE 25.-*Number of vines and production of grapes in Mexico, by principal States, 1937-41*

STATE	NUMBER OF VINES					PRODUCTION				
	1937	1938	1939	1940	1941	1937	1938	1939	1940	1941
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
Coahuila . . .	2,009	2,148	2,183	2,367	2,580	8,228	8,086	7,700	6,347	9,305
Chihuahua . . .	196	194	171	208	246	519	493	419	498	543
Durango	191	198	228	234	266	464	578	794	645	663
Zacatecas . . .	80	79	83	87	86	283	318	317	378	512
Baja California	620	693	818	1,208	1,554	1,762	2,226	2,417	3,490	5,110
Sonora	67	77	91	93	120	311	390	479	493	610
Aguascalientes.	54	158	250	322	343	190	523	821	698	810
Others	235	240	263	259	279	920	936	964	1,085	1,102
Total	3,452	3,787	4,087	4,778	5,474	12,677	13,550	13,911	13,634	18,655

Compiled from official sources.

CULTURAL PRACTICES

Cultivation

The cultivation of deciduous fruits varies considerably among the different districts and is influenced by types of soil, crops peculiar to the region, topography of the land, and local custom. In general, the orchards receive some form of cultivation, but usually any tillage is for the purpose of preparing the soil for the planting of intercrops. On plateaus and in mountain valleys, where the land is fairly level, animals and machinery are used, but in orchards planted on steep mountain slopes most of the cultivating is done by hand. On level land the entire field is cultivated, but in the mountainous regions only the area around and under the trees is worked and kept free of weeds. The space between tree rows is seldom broken because of the danger of soil erosion. Most of the work performed by hand is done with a heavy, broad-bladed hoe, which, like the machete, is used by the worker with great skill.

If animals are used in working around the trees, mules are preferred to oxen because the latter have a habit of rubbing against the limbs of the trees in order to brush off the flies. This results in many broken limbs and branches.

Most orchards are kept fairly clean and free of weeds, but no established system of soil management

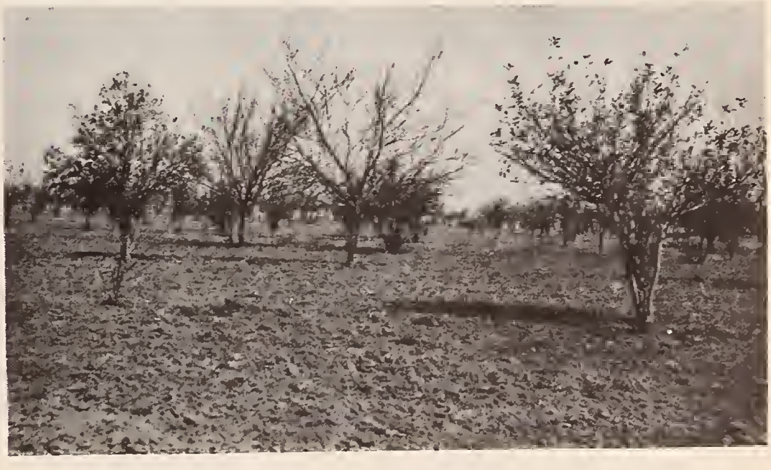


FIGURE 117.-A clean-cultivated orchard in Puebla.

is practiced. The question as to whether clean cultivation has advantages over sod mulch, or vice versa, is not considered. When the land is sufficiently level to permit the growing of intercrops, it is cultivated as intensively as conditions will allow and as close to the trees as possible, in order to take advantage of every inch of available land.

Cover Crops and Intercrops

Cover crops are sometimes grown in the orchards, primarily for livestock feed rather than for improving the soil. Weeds, grass, other volunteer crops, and natural covers are those most generally used. In some cases, they are cut and allowed to remain as a mulch, but the practice is not general.

Intercrops are widely cultivated; in fact, they are depended upon as the chief source of revenue. Arable land is scarce, and every acre that can be made to produce is planted to some cultivated crop. Corn, beans, cereals, a few vegetables, and occasionally small fruits are some of the crops used.

Pruning

If the fruit trees are trained or pruned, no particular pattern or system is followed. Few growers understand the principles of pruning, and no particular effort has been made to enlighten them. Mexico offers a most fertile field for extension workers in horticulture. Some good work is being done, but the surface has not been scratched. Material for demonstration purposes is available on every hand, and some startling results could be accomplished if the necessary provisions were made. When pruning is attempted, the operation is usually inexpertly performed, and the vase or open-center method is preferred. Cutting is severe and patterned after European methods. The new growth is headed back heavily each year and the tree kept short and stocky.

In most cases young trees receive no training at all. Several shoots originating at or below the ground level are allowed to develop into what amounts to two or three trunks. Each of these trunks or limbs is allowed to develop at will, and the result is usually a thick, bushy, tangled mass of crossing, interfering, and interlacing limbs and branches.

The formation of the tree in most cases is bad. It is headed anywhere from a few inches above ground level up to 5 or 6 feet. In the flat country, low-headed, compact, bushy trees are the rule, but in the mountainous districts the custom is to head them high in order to facilitate hoeing and other operations around and under the trees. Most trees are badly formed because of neglect or inexperience. All trees, irrespective of species or variety, usually

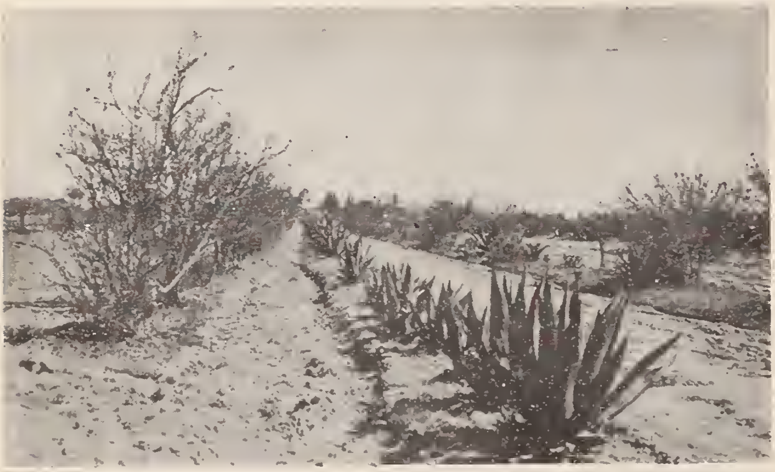
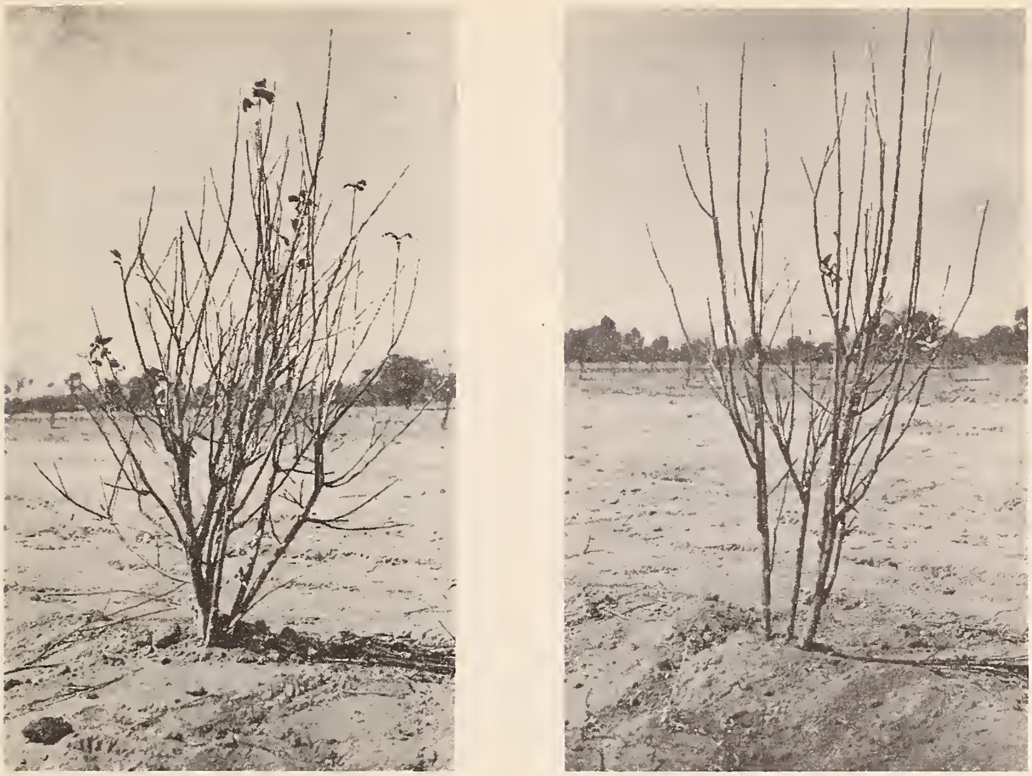


FIGURE 118.-An orchard in Puebla intercropped with maguey, corn, and beans.



FIGURES 119 AND 120.-Examples of pruning as practiced in Puebla.

have a superfluity of badly spaced branches and weak crotches. Grapes, on the other hand, are well trained and pruned.

Fertilization

Fertilizers are seldom applied for the express purpose of supplying the tree with plant food but rather to stimulate the growth of the intercrops. The rate of tree growth in those districts visited by the writers plainly indicated the lack of soil fertility. This was especially true in the western parts of the State of Puebla, where the soil is loose and powdery, although high altitude also affects growth. Trees 8 to 10 years old are in most instances no larger than 3-to-4-year-old trees produced on a good strong soil.

Irrigation

Deciduous fruits are produced in both irrigated and nonirrigated areas. In the irrigated districts the methods of applying water usually follow long-established customs peculiar to the locality. In some cases, the furrow method is used, but in others the flood or basin system is followed. Irrigations are usually started in the spring and continued through August. The number of applications depend upon type of soil, climatic conditions, and nature of the crop or crops produced. If water is plentiful, the trees do not suffer for want of moisture; in fact, the tendency is to overirrigate rather than to apply too little.

In the districts where deciduous fruits could be produced to the best advantage, there is a shortage of water, and production is therefore restricted to the amount of water available.

Insect-Pest and Disease Control

Most of the pests associated with deciduous fruits and familiar to fruit growers in the United States are present in Mexico. From a United States grower's point of view many of them would be regarded as serious; but, since conditions in Mexico are quite different from those in most other countries, control measures have not been considered essential. In some cases, weather conditions and natural enemies exercise a fairly good control and tend to keep the pests in check. In other instances, they seem to have things pretty much their own way and cause considerable damage to the fruit.

Since the supply of fresh deciduous fruit is usually far short of the demand, the consumer has not developed a quality-conscious complex and does not discriminate between good and bad. Appearance and grade defects are not determining factors in the marketing of fruit in Mexico. Though clean unblemished fruit is appreciated, the presence of specks, spots, blotches, or holes does not seriously interfere with its sale. Since the cost of imported fruit is prohibitive and its sale is restricted, the domestic product is in a position to enjoy a wide distribution at a good price. Insofar as the grower can see, there is no reason why he should spend money unnecessarily just to make a better presentation. There are no recommended spray schedules for the country. Growers have never been urged to spray, and most of them would not know how to prepare and apply the material; consequently, little spraying is done. A few of the larger growers make some attempt at control measures, but their efforts are largely neutralized because the large majority of neglected orchards serve as perfect hosts for the unrestricted development and unrestrained conduct of these pests. In some localities, effective control measures could be carried out without great effort and expense, but in the more mountainous areas they constitute a difficult problem. In some instances, the use of a knapsack sprayer would be the only solution. but it would be difficult for the operator to get on a good coverage and to retain his footing at the same time.

Old orchards, especially, show the need for at least an occasional spraying. They are often covered with moss and lichen, particularly in the districts where rainfall is heavy and the climate cool and damp.

In the arid regions insect pests are more troublesome than diseases, but in the more humid areas both are equally abundant.

Harvesting Dates and Methods

In general the fruit crop in Mexico is harvested during periods approximating those in the United States. The season opens with apricots and finishes with apples. The actual dates on which harvesting begins vary considerably, not only between States, but within a State itself. Elevation and exposure have an extremely important bearing upon fruit culture in Mexico. These two factors exert a greater influence upon the blossoming, length of growing season, and the ripening of fruits than all others combined. Because of the vast system of mountain chains, there are hardly two districts in the country where climatic conditions can be called identical. On one side of a mountain conditions typical of a temperate climate may prevail; on the opposite slope they may approach subtropical, or even tropical. Fruit in the valleys may blossom from 2 to 3 weeks earlier than that planted higher up on the slopes. In other words, conditions are similar to those found in other fruit-growing regions of the world, but they are more pronounced. The same lapse that occurs in the harvesting of the pear crop in California, or the cherry crop on the Pacific coast, or the peach crop along the Atlantic seaboard, occurs in Mexico. The harvest in the hot arid valleys, or plateaus, is over before the crop from the higher mountainous regions is ready to move. In the United States, the progression of ripening dates is largely a question of latitude, but in Mexico it is one of altitude, or exposure, or a combination of both.

The blossoming period begins in February and March and continues through April. Harvesting starts in May and usually ends in November. In other words, seasons in Mexico, though somewhat earlier, are much the same as in the United States. The South American season, on the other hand, is exactly opposite to that of the United States.

Methods of harvesting and handling the various fruits are much the same as those employed for oranges and limes. The industry lacks organization of every kind, and the practices followed are crude and primitive. Even the tenderest of fruits are handled in an extremely rough manner; and it is remarkable that they survive as well as they do. Generally, the fruit is gathered, dumped into baskets or crates just as it comes from the trees, and shipped to market. In certain districts, Chihuahua for example, the industry is somewhat better organized, and some attempt is made toward selection and packing. This is unusual, however. Mexico has never attempted to promulgate grades or set up packing requirements, and the industry has never been called upon to improve its standards as a means of improving marketing conditions. Frequently, fruit is poured into sacks and transported to market on the backs of burros, but apples shipped to Mexico City from Chihuahua and Durango are packed in boxes.

Packing houses and equipment that constitute a familiar part of the fruit industry in most countries are unknown in Mexico. No such facilities are under construction, and as far as the writers could learn, nothing of this nature is being considered.

Packages or Containers

Unlike oranges, most deciduous fruit is jumble-packed in boxes, or crates, and shipped to market in crude home-made containers. The crates are made of bamboo or fairly heavy branches that are notched at the ends, log-cabin fashion, and bound together with rope or leather thongs. No effort has been made to standardize fruit packages, because the need has not become apparent. When packaged at all, the fruit is placed in any type of container that is handiest or most readily available.

Production Costs

Records pertaining to growing or harvesting operations are not kept; therefore, it is impossible to obtain even approximate growing costs. In most instances, the fruit crop is, as already stated, considered incidental to the more important staple crops, such as corn, beans, etc. Repeated efforts have been made to get approximate or probable costs in order to arrive at some basis of comparison, but even this was impossible. The operator, in certain cases, may have had some knowledge about costs but was reluctant to divulge it. More often, however, the costs were really unknown.

Even though production costs were obtainable, they would not have much significance, since the industry is hardly comparable with that of the United States or of other commercial fruit-producing countries. In any event, growing costs cannot run into any important amounts, because little is spent other than for cultivation, and this consists mostly of expenditures for work to prepare the land for other crops.

Pruning, spraying, fertilization, thinning, and all other operations familiar to most orchardists are neglected. Except for the cost of the land occupied by the trees, any revenue received, can, in most instances, be regarded as clear profit.

Prices Received by Growers

Considering the quality of the fruit produced in Mexico, growers are well paid for their efforts. Local supplies find a ready sale in the local markets, largely because they can be sold much more cheaply than imported supplies. Boxed apples, for example, from Chihuahua usually cost the buyer around 8 pesos ($1.60) per box delivered in Mexico City. They are sold at around 12 pesos, which gives the buyer a good margin of profit. Imported apples, on the other hand, as already noted, cost around 22 pesos per box and are sold for from 24 to 25 pesos.

Growers of perones and manzanas usually get around 50 centavos per kilo, or about 12 pesos per bushel for their fruit.

Average prices per kilo for the following fruits are about as follows:

FRUIT	CENTAVOS PER KILO	CENTS PER POUND
Apples (red and yellow)	50	5
Apricots	85	8
Peaches	30	3
Peaches (canning)	20	2
Pears	60	6
Plums	40	4
Quinces	35	3

Transportation Facilities and Charges

The transportation problems encountered in the movement of oranges and limes apply also to deciduous fruits. Most of the fruit sold in Mexico City and the larger markets is shipped by rail, but shipment by motor truck is on the increase and threatens to offer increasing competition. Burros are the most common means of transportation to the nearby local markets.

Cold-Storage Facilities and Charges

Facilities for storing fruit are not only limited but in most cases are not altogether satisfactory. Mexico City has several cold-storage plants that are capable of filling the average requirements, but they are said to be undependable. Although the services have been improved during recent years, there is still much to be done before they can be considered safe for the storing of fruit. The circulating-air system has been installed recently in some plants, but the majority are still using the brine system. Difficulty is experienced in maintaining uniformly low temperatures, and break-downs frequently occur that require up to 48 hours to repair. Experiences of this kind are costly, and importers of high-priced fruit cannot afford to run the risks involved. In most cases, importers of United States fruit purchase their requirements early, store the fruit in the United States, and have it shipped out through the marketing season in accordance with market requirements. The local cold storages, therefore, are used primarily for holding fruit for short periods only. Importers maintain a room, or contract for a certain amount of space in one of the chambers. When a car of fruit arrives in Mexico City, it is unloaded, transferred to storage, and removed from day to day, a few packages at a time, or as the demand situation requires. The charges for storage space usually run around 4.50 pesos per cubic meter or 40 centavos (8 cents in United States currency) per box per month.

MEXICAN FRUIT MARKETS AND MARKETING METHODS

For the past several years the expansion of the Mexican fruit industry, especially citrus fruits, has been predicated upon a growing home market. While it has been intimated on one or two occasions that Mexican oranges might be wanted abroad after the war, most growers have given no thought to export possibilities and are thinking in terms of the home market only. Mexico has been producing oranges for many years, but their distribution has been limited to the few markets that are most accessible and within easy reach. With the extension of railways and highways, however, additional outlets have been opened up, and many people who formerly seldom saw an orange are now able to obtain them at fairly reasonable prices. The vast majority of people throughout Mexico are still unaccustomed to eating oranges, but as transportation, social, and other conditions continue to improve, the fruit-eating habit will grow and a wider consumption is to be expected. Motor trucks are already delivering oranges and other fruits to markets that are without rail facilities, or to towns through which the railroad passes but whose population is too small to handle a carload or even part of a car of fruit. Fruits, especially oranges, are now available in quantity in many small towns and villages that were formerly dependent on the limited amounts grown locally.

The principal market for fruit in Mexico is Mexico City, the capital, which, as in most Latin American countries, is the center of population, with the greatest concentration of wealth. Furthermore, most roads lead to the capital, and a natural tendency is to focus attention on that spot, ignoring possibilities which might lie in other directions. There are several cities, such as Monterrey, Veracruz, Puebla, and Guadalajara, all of which offer excellent opportunities for market expansion.

Certain growers interviewed with regard to expanding production are of the opinion that Mexico can utilize an increase up to 100 percent, if an effort is made to stimulate consumption as has been done in other countries. Some growers have been advocating an advertising campaign, which they feel would result in a substantial increase in consumption. At the same time, they realize the lack of an organization through which the program could be projected.

At present all oranges are sold in the fresh state, but the establishment of plants for the manufacture of juice and concentrates is under discussion. Something along this line may

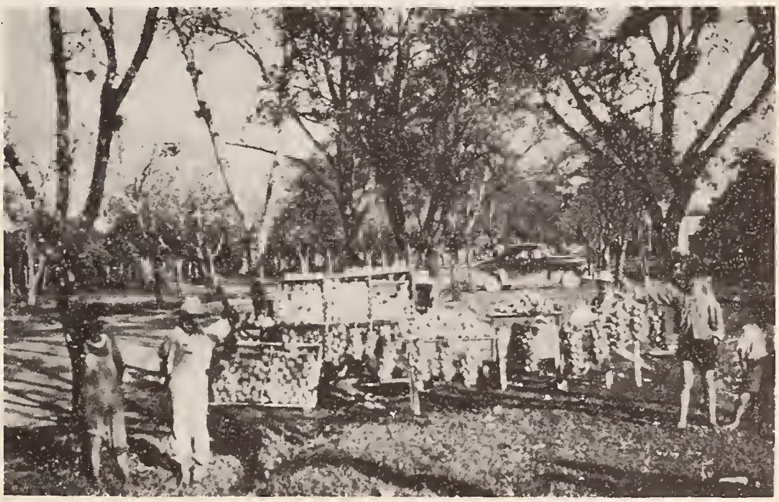


FIGURE 121.-Selling oranges at a roadside market.

possibly be undertaken within the next year or two. The idea, however, is still in a formative period, and no definite action has been taken.

Oranges are usually purchased on a strictly cash basis. In a few special cases credit is extended but only when buyer and seller are well known to each other. It is customary for a buyer to visit a district and make calls upon each individual grower. The price is determined on the basis of variety and season.

As a rule, contracts are drawn up on a weekly basis, since the value of the fruit increases as the season progresses. All fruit is sold by count, rather than by volume; for example, an agreed amount per 1,000 oranges. Quality does not figure prominently in the transaction; the understanding is that the very worst specimens will not be included. The principal stipulation is in connection with size and "plugged" oranges. Only the smallest oranges, which are few in number, and fruits with a torn or pulled-out skin are excluded. Although smaller and less damaged fruits are included, they are discounted from 40 to 50 percent under the sound fruit and preferred sizes.

After the question of price has been settled, the buyer arranges about delivery. The grower prefers to sell to truckers because pick-up is made at the orchard, which eliminates cartage charges to the nearest railway. In many cases, however, sales are made on the basis of a specified amount delivered at the car. In either case, all fruit is sold in bulk.

Sorting takes place at the time the fruit is counted out for delivery to the truck or car. This transaction is supervised by two men, mutually agreed upon; one represents the buyer, the other the seller. The arrangement is said to work out quite satisfactorily. As the oranges are counted out into baskets prior to loading, the small and inferior fruits are thrown aside and taken into consideration later. When the truck or car is loaded, all responsibility on the part of the seller ceases. The grower at this point not only severs his identity with his fruit but loses all further interest in it. He is not concerned about its condition upon arrival, the price it brings, or the reaction of the trade or consumer.

When fruit is shipped by truck, it may be marketed at different points along the highway or may roll straight through to one of the larger cities. Upon arrival oranges are usually stored in a warehouse, where they are withdrawn in small lots for the thousands of peddlers or small shopkeepers, who operate small open-air stands or barrows, or who sell from piles laid out on the sidewalk. Orange-juice stands are set up along the plazas and street corners where the juice, squeezed from the oranges

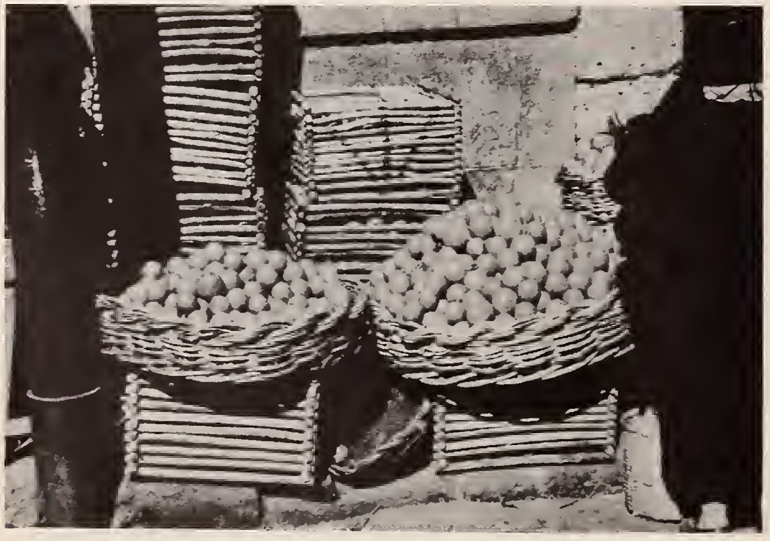


FIGURE 122.-Typical wholesaler's display of oranges in a market in Mexico City.

with the aid of a small hand press, is kept in pitchers or large glass containers and sold for a few centavos per glass. Increasing quantities of oranges are being marketed in this way.

Deciduous fruits, particularly apples, are marketed quite differently from citrus fruits. A large part of the actual marketing of the crop is done by the grower himself.

For an example, Puebla, which is some 50 to 60 miles from Mexico City, is an important producing center of perones. A large part of this crop is sold in Mexico City. The grower makes or supervises the sale of his crop instead of turning it over, or consigning it, to others. The fruit is transported to the city in boxes or crates and stored in a warehouse or building in the vicinity of one of the numerous market places. Usually the grower, or a group of growers, will rent space in a building and use it not only for storing fruit but as a salesroom. Rental is collected at the rate of 10 centavos (2 cents) for each box of fruit that is stored or handled on the premises. Where apples are purchased f.o.b. from growers at distant points, such as Chihuahua or Durango, sales are handled on the premises permanently occupied by the merchant.

There are no commission agents, jobbers, wholesalers, or auction brokers, such as handle the distribution and marketing of produce in most large cities or countries throughout the world. Also there are few exporting-importing firms dealing in fruits and vegetables. Most of the trading is in small broken lots, and resembles a retail, rather than wholesale, business in which thousands of people are engaged.

All cities, towns, and villages have their market places, but they are quite different from those found in the northern countries, or in fact, even in the larger

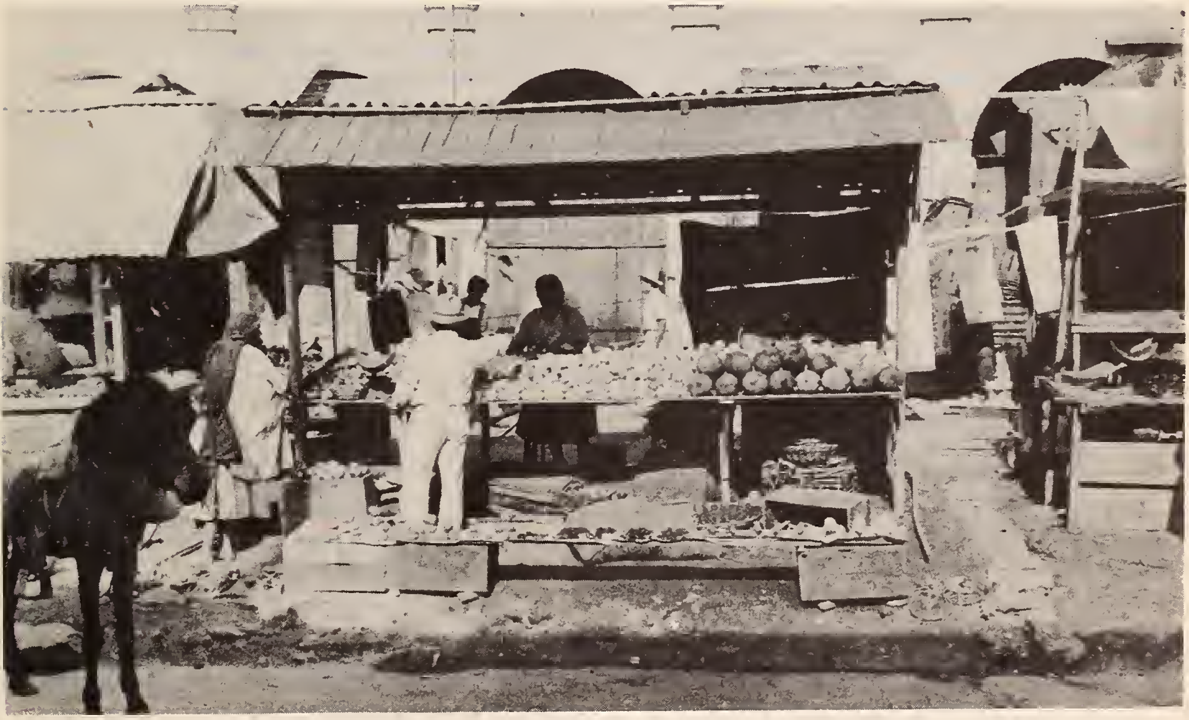


FIGURE 123.-Typical stand in the market place of a middle-sized town.

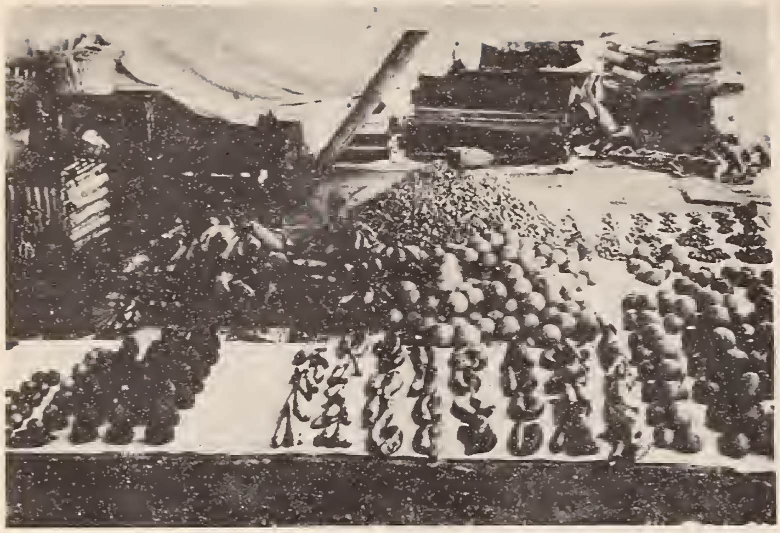


FIGURE 124.—Typical fruit stall with fruit displayed on the ground during market day in one of the villages. This picture, taken in January, shows the variety of fruits available to the public even in winter. There are four kinds of bananas, and one of plantain, cherimoyas, granadillas (or passion fruit), oranges, and the ever-present "goober."

of the South American countries. They are truly marketing centers, where buyers and sellers gather to exchange or sell their wares. A Mexican market place offers a wide range of articles, such as dried and fresh fruits of various kinds, vegetables, charcoal, gadgets of all sorts, serapes, herbs, livestock, beans, fowls, peppers, parrots, and what not. Even in the larger cities the markets are general in nature; that is to say, they deal in many, rather than in a few, special products. There is no district set aside for fruit, another for meat, another for poultry, butter and eggs, and so on. Some segregation occurs, but fruits, herbs, serapes, and dairy products are, as a rule, pretty much mixed up.

Mexico City has about 22 market places scattered about in different parts of the city, of which 4 are outstanding in size and importance. La Merced is located in the eastern part of the city, La Lagunilla in the north, San Juan serves the central section, and San Cosmé takes care of the people living in the western part of town. The busiest time of day is between 9 and 1 o'clock. During this period there is much congestion and confusion. The afternoons are usually dull, and little business is transacted. In addition to the shops, which line both sides of the narrow streets, small stands are set up on the outer edge of the sidewalks and in the streets next to the curb, whereas many peddlers spread their wares out on the sidewalk or in the streets. In most instances, stocks are very small, and sales consist of a bit of this and a few bits of that. Some sellers may have as much as a crate or two of different fruits, whereas others may have as little as a dozen or 20 oranges, a few sapotes, a few perones, a hand or two of bananas, a few peppers, a pint or so of peanuts, and so on.

In the smaller towns the market place is either around or adjacent to the plaza. Every town in Latin America has its plaza. It is the axis around which the town is built and, of course, the center of all activity. The church or cathedral, the hotel, and the main business houses are built facing the square. Often the square or plaza is used every day by the vendors of foodstuffs; in other cases market days are held on certain days of the week. Market day, in fact, is a great event in the life of the people. The trek to the town or village begins early in the morning and for several hours all roads and trails leading to "Rome" are filled with farmers and their families trudging along to market. Some prod heavily laden burros, others carry loads on their backs or balanced on their heads; others lead a pig or a goat by a string or rope tied to its hind leg; and others carry fowls or drive turkeys.

Upon reaching the plaza, or market square, they break up into different groups. In one section they spread their fruits, vegetables, peppers, and herbs. The charcoal sellers pick another spot, and the livestock merchants select another. A large part of the day is spent in visiting, swapping a sack of beans for a pig or some apples for a chicken, and in disposing of the products of the farm, irrespective of their nature. Market day in any small Mexican country town is a colorful, interesting, and fascinating adventure - an experience long to be remembered.

MEXICO AS A MARKET FOR UNITED STATES FRUIT

Mexico, like most other Latin American countries, cannot be measured in terms of population. A large population from an exporter's view is most certainly an essential requisite, but millions of people expressed in terms of a small income, a low standard of living, and limited purchasing power cannot readily be converted into customers for United States fruits. Mexican fruit is not competitive with imported supplies as far as quality is concerned, but it has the advantage of being plentiful and cheap. Cheapness, in fact, is of first importance, and quality, condition, appearance, etc. are secondary; There is an outlet for everything somewhere in Mexico, provided it is cheap enough. Even partially decayed fruit is utilized in some way. When it becomes necessary to recondition fruit and to separate the good from the bad, the rejections are not destroyed but sold to the poor who manage to salvage something out of them. Half-rotted imported grapes, for example, removed from the bunches are not thrown away, since they will fetch a few centavos for a handful.

The price of imported United States fruit is far beyond the reach of a large part of the people. The demand for it is confined to a small group composed of those within the higher income brackets. Even within this class the demand comes largely from foreigners - other North Americans, French, Italians, and Spaniards. The Mexican people are not fruit conscious to the same degree as are Europeans, or other Americans, and are not educated to pay fancy prices for fruit simply because it is attractively presented or out of season. This does not mean that they do not enjoy United States fruits, or that they are not interested in imported supplies after their own supplies are exhausted. Mexicans are fruit eaters, they have a desire for it, but their appetites, as is true in all other countries, are limited by their purchasing power.

That Mexico offers a market for fruit produced in the United States, provided it can be laid down at a reasonable price, is perhaps best illustrated by United States export figures (see table 26). The volume of exports falls within three well-defined periods, 1926-30, 1931-35, and 1936-40. The first period reflects the movement when duties were low and imports into Mexico encountered a minimum of difficulties; the second illustrates the results of retaliatory measures, which appeared in the form of high duties instituted to offset the increases applied against Mexican products entering the United States; the third period shows a gradual improvement in the import position due to more favorable exchange rates, stability of government, and economic conditions.

Prior to 1930 or before the advent of high duties, United States fruit entering Mexico amounted to an average of 321 cars annually. From a total of 341 cars in 1930 when duties were assessed at the rate of 10 centavos per kilo (2.18 cents per pound), shipments in 1931 dropped to 38 cars, under the new rate of 35 centavos per kilo (5.80 cents per pound), a decrease of 89 percent. In 1935 imports began to pick up slightly, but for the 5-year period 1931-35 the average amounted to only 59 cars. The third period, 1936-40, shows a further improvement, with an average annual import of 177 cars.

TABLE 26.-*Exports of fresh fruit from the United States to Mexico, 1926-40*[1]

YEAR	GRAPES		APPLES		PEARS		PEACHES		PLUMS		CHERRIES	
	1,000 pounds	*Cars*	*1,000 pounds*	*Cars*	*1,000 pounds*	*Cars*	*1,000 pounds*	*Cars*	*1,000 pounds*	*Cars*	*1,000 pounds*	*Cars*
1926 . . .	1,697	68	5,499	167	555	20	267	11	-	-	-	-
1927 . . .	2,174	87	4,032	122	586	21	304	12	-	-	-	-
1928 . . .	3,340	134	5,493	166	858	31	292	12	-	-	-	-
1929 . . .	3,081	123	4,561	138	797	28	241	10	-	-	-	-
1930 . . .	3,396	136	4,661	141	1,059	38	243	10	-	-	-	-
Average.	2,738	110	4,849	147	771	28	269	11	-	-	-	-
1931 . . .	406	16	509	15	174	6	24	1	-	-	-	-
1932 . . .	618	25	233	7	80	3	61	2	-	-	-	-
1933 . . .	838	34	1,065	32	173	6	43	2	-	-	-	-
1934 . . .	990	40	670	20	203	7	72	3	-	-	-	-
1935 . . .	1,136	45	679	21	183	7	50	2	-	-	-	-
Average.	798	32	631	19	163	6	50	2	-	-	-	-
1936 . . .	1,506	60	1,260	38	283	10	142	6	62	3	21	1
1937 . . .	2,970	119	1,845	56	563	20	250	10	181	9	24	1
1938 . . .	2,975	119	2,698	82	563	20	224	9	142	7	28	1
1939 . . .	7,976	319	2,691	82	504	18	254	10	148	7	40	2
1940 . . .	7,748	310	3,051	92	747	27	224	9	183	9	24	1
Average.	4,635	185	2,309	70	532	19	219	9	143	7	27	1

YEAR	APRICOTS		ORANGES		GRAPEFRUIT		LEMONS		OTHERS		TOTAL	
1926 . . .	-	-	387	11	11	(2)	65	2	1,165	58	9,646	337
1927 . . .	-	-	471	13	17	(2)	43	1	928	46	8,555	302
1928 . . .	-	-	432	12	15	(2)	48	2	962	48	11,440	405
1929 . . .	-	-	1,064	30	36	1	199	6	934	47	10,913	383
1930 . . .	-	-	603	17	42	1	178	6	740	37	10,922	386
Average.	-	-	591	17	24	(2)	107	3	946	47	10,295	363
1931 . . .	-	-	157	4	9	(2)	63	2	15	-	1,357	44
1932 . . .	-	-	84	2	7	(2)	23	1	-	-	1,106	40
1933 . . .	-	-	81	2	4	(2)	17	1	-	-	2,221	77
1934 . . .	-	-	965	28	22	1	73	2	-	-	2,995	101
1935 . . .	-	-	1,130	32	16	(2)	47	2	-	-	3,241	109
Average.	-	-	483	13	12	(2)	45	2	2	-	2,184	74
1936 . . .	-	-	1,087	31	19	1	42	1	-	-	4,422	151
1937 . . .	47	2	1,031	29	14	(2)	41	1	-	-	6,966	247
1938 . . .	45	2	3,992	114	57	2	57	2	-	-	10,781	358
1939 . . .	55	2	4,853	139	1,181	37	93	3	-	-	17,795	619
1940 . . .	62	3	5,427	155	107	3	144	5	-	-	17,717	614
Average.	42	2	3,278	94	276	9	75	2	-	-	11,536	398

[1] Export figures converted from pounds to carlots on the following bases: Grapes, 25,000 pounds to the car; apples, 33,000; pears, 28,000; peaches, 25,480; plums, 20,000; cherries, 20,000; apricots, 23,000; oranges, 35,000; grapefruit, 32,000; lemons, 31,000; and others, 20,000 pounds to the car.

[2] Less than one-half car.

Compiled from official records of the Bureau of Foreign and Domestic Commerce.

About 50 percent of the fruit imported from the United States enters in quantities of less than a carlot. Many of the border towns, such as Juárez, Nuevo Laredo (a Mexican town across the border from Laredo, Texas), and Matamoras, are supplied from the markets on the United States side. Delivery is made by truck; in this way the markets are supplied with a greater variety of fruits and vegetables than would otherwise be possible and in quantities that are more in keeping with the requirements of the market.

Mexico City, in fact, is the only market in Mexico capable of handling imports in carload lots. According to importers located there, imports prior to 1930 ranged between 150 and 200 carloads. Since that time, however, imports entering Mexico City have averaged around 75 to 85 cars.

In comparing Mexican import figures with United States export data, a wide discrepancy is apparent. Mexican figures apparently fail to include the border crossings consisting of small broken-lot shipments. For example, imports of oranges for the 5-year period ending 1940 are shown to average 55 boxes, whereas United States export figures for the same period show an average annual movement of 40,972 boxes. A similar disparity between imports and exports exists in the case of all other fruits.

Since practically all the fresh-fruit imports originate from the Pacific Coast States, this region has had to absorb the full impact of the new order. Of the various types of fruits imported into Mexico, grapes are the most important. Although Mexico produces from 12,000 to 14,000 tons of grapes, they are mostly wine varieties. A statistical break-down between table and wine grapes is not available, but, according to estimates, around 90 percent of the total production consists of wine grapes. The grape-marketing season is short; it commences in May and lasts through August. The fruit is produced in areas that have frequent summer rains. Lack of sunshine and heavy showers during this critical period are not conducive to either good eating or shipping quality. The consuming public has a definite preference for the imported California product, but its cost by the time it reaches the retailer is so prohibitive that mass consumption is impossible.

Prior to the increase in duty the wholesale value of grapes averaged around 80 to 90 centavos per kilo (17.1 to 19.2 cents per pound at the average annual exchange rate for 1930) and were retailed for about a peso (21.4 cents). Under the revised schedule the value, both wholesale and retail, was increased by 100 percent. In March 1942 the c.i.f. value of grapes in Mexico City amounted to 1.65 pesos per kilo (15.4 cents per pound), and they were retailed at from 1.80 to 2.00 pesos per kilo (16.8 to 18.7 cents per pound). In the interior markets, because of additional handling and transportation costs, the fruit had to be retailed at around 2.50 pesos per kilo (23.3 cents per pound) in order to show a profit.

Under present conditions a total of around 20-25 cars of grapes are imported into Mexico City. The first carlots of the season, which are of Thompson Seedless variety, are greatly appreciated and their popularity continues as long as they are available, or until about the middle of January. A few Tokays and Malagas are also imported but usually in small lots. Ribiers and Emperors are held for late marketing and are usually shipped in solid cars. As a rule they are available up to the end of January, but in 1942 they were observed in many markets throughout the country near the end of March. Emperors are sold as late as May. A shipment that arrived in Mexico City the middle of March was in almost perfect condition. The stems were green, succulent, and full of life. The berries were fresh, bold, and plump. Decay was negligible.

The Los Angeles lug is the only type of package used. The display lug is not suitable for Mexican conditions. Sawdust-packed chests are not wanted. Since the duty is assessed on the basis of gross weight, importers claim that they cannot afford to pay duty on sawdust.

The market for pears is limited, and stone fruits can be sold only in small quantities. The outlet is not sufficiently large to warrant straight cars, and the movement consists almost entirely of mixed cars or broken lots.

Importers in Mexico are of the opinion that, if the duty on fruit could be lowered by one-half, imports could be increased up to 100 percent; and if brought down to its former level of 10 centavos per kilo, the business should increase up to

150 to 200 percent. Importers attribute the higher duties on fruit entering Mexico to the increased duties levied on winter vegetables entering the United States from Mexico as provided for in the 1930 Tariff Act.

The production of winter vegetables for the United States market was originally undertaken by Americans who took up land in the richer valleys in the western part of the country. Irrigation projects were developed, and the land was cleared and prepared for truck crops. This enterprise apparently took place shortly before the revolution in 1910, since the earliest recordings of carlot shipments from Mexico to the United States are those of 1912. During the revolutionary period in Mexico (1910-20), which ran almost concurrently with the world war (1914-18), development was slow, largely because of the impact of war upon the United States economy. Following the war, with the return of more stable political conditions in Mexico, interest in the winter-vegetable industry was revived. This interest, financial and otherwise, was shared by a number of the influential citizens of Mexico. When United States duties were increased, this business could no longer be conducted at a profit; as a result, acreages had to be drastically curtailed or abandoned. Many of the people mentioned above suffered heavy personal losses.

The peak season for winter vegetables was reached in 1930. Shipments during 1931 and 1932 were on a par with those of 1927, 1928, and 1929, but in 1933 there was a sharp reduction. Until 1941, the annual movement was fairly constant but at levels considerably under those for the 1927-32 period.

TABLE 27.-*Carlot shipments of winter vegetables from Mexico to the United States, 1912-42*

YEAR	CARS	YEAR	CARS	YEAR	CARS	YEAR	CARS
	Number		*Number*		*Number*		*Number*
1912 . . .	441	1920 . . .	864	1928 . . .	6,017	1936 . . .	2,798
1913 . . .	195	1921 . . .	1,003	1929 . . .	6,104	1937 . . .	4,174
1914 . . .	0	1922 . . .	1,415	1930 . . .	8,350	1938 . . .	2,335
1915 . . .	79	1923 . . .	2,198	1931 . . .	6,089	1939 . . .	1,613
1916 . . .	91	1924 . . .	2,694	1932 . . .	6,025	1940 . . .	1,808
1917 . . .	143	1925 . . .	3,507	1933 . . .	2,324	1941 . . .	5,161
1918 . . .	486	1926 . . .	4,414	1934 . . .	1,201	1942 . . .	6,602
1919 . . .	666	1927 . . .	6,337	1935 . . .	2,737		

Compiled from records of the Traffic Department, Southern Pacific Railway Company of Mexico.

Three main reasons are ascribed to this shift in movement. The tariff act of 1930, which raised the duty on imports, became effective for the 1931 season. During that year, however, and again in 1932, shipments were maintained at a fairly high level, possibly carried along by the momentum to which the industry was already geared. In 1933 the effects of the depression in the United States, combined with the raise in tariff, marked the beginning of a series of years in which prices and movement remained at low ebb. After the depression period, some improvement might have taken place, because of increased consumer income, had not an expansion in the winter-vegetable industry of Texas and Florida developed to take up the slack. Whenever supplies from these areas are available in quantity, Mexico is unable to compete in volume equal to the 1927-32 movement.

Aside from these economic forces, changes also occurred within the Mexican industry for the reason previously stated. A large part of the area developed for truck gardening was expropriated, which had an adverse effect upon the industry.

This condition, however, did not last long, and the previous type of management was soon resumed, the lands being leased from the new landowners and ejidatarios. Reliable reports state that in certain instances as much as 90 percent of the better lands in some of the vegetable districts were distributed among agrarians, who show a growing tendency to lease their holdings to private growers. Estimates indicate that only about one-third of the cultivated area held by agrarians is actually being farmed by them. The remainder is leased out to private individuals, who are paying around $50 (United States currency) per car for the use of the land, or, in other cases, from 5 to 20 percent of the crop in the form of rental.

At the present, the production of winter vegetables could apparently be increased substantially with existing equipment and organization. As a result of wartime conditions, the production of these crops in the States of Sinaloa and Sonora is expected to increase. Under normal conditions, however, the industry will probably continue at moderate levels supplying certain markets and enjoying a wider distribution during a few months of the year when the United States market is in short supply.

Under the terms of the trade agreement between Mexico and the United States, signed December 23, 1942, substantial concessions were made in the reduction of duties on vegetables entering the United States. It is too early, however, to draw any conclusions as to the resulting benefits, since existing conditions are abnormal and increased imports can be attributed largely to war conditions. The results, however, should be favorable, since reductions in many instances amounted to 50 percent of the preagreement schedule. The effect of the agreement on exports of fruit from the United States to Mexico is not likely to show much change, since the reductions in most instances are too small to have any influence one way or another.

No suggestion is made that the Mexican market is capable of absorbing large quantities of United States fruits. Some claim, however, that under more favorable conditions it could be developed into an outlet of reasonable importance. At the present, grapes account for over 50 percent of all the fruit shipped to Mexico City from California. Stone fruits arrive in insignificant amounts, which total from 10 to 12 cars a year. The Mexican is fond of these fruits, but domestic production is so uncertain that they are usually denied to him. The market, especially for plums, could be easily increased under more favorable conditions.

The duty and other customs charges collected at the border account for almost one-third of the laid-down cost of imported fruit. In most cases, it is about equal to and, in some instances, exceeds the invoiced value of the fruit. The following are typical examples of actual transactions and serve to illustrate the difficulties, risks, and high charges involved in making United States fruit available to the Mexican people.

TABLE 28.-*Cost of a car of Emperor grapes of 882 lugs shipped from Fresno, California, to Mexico City*

ITEM	COST PER CAR		COST PER BOX	
	Pesos	*Dollars*	*Pesos*	*Dollars*
Invoice price	6,552	1,351	7.43	1.53
Freight, Fresno to El Paso	1,901	392	2.16	.45
Duties	5,094	1,050	5.78	1.19
Express, Juárez to Mexico, D. F.	1,926	397	2.18	.45
Total	15,473	3,190	17.55	3.62

Compiled from official sources.

TABLE 29.-*Cost of a car of Anjou pears of 520 boxes shipped from Medford, Oregon, to Mexico, D. F.*

ITEM	COST PER CAR		COST PER BOX	
	Pesos	*Dollars*	*Pesos*	*Dollars*
Invoice price	5,786	1,193	11.13	2.29
Freight, Medford to El Paso	1,887	389	3.63	.75
Duties and other expenses	4,913	1,013	9.45	1.95
Express, Juárez to Mexico, D. F.	1,724	355	3.32	.68
Total	14,310	2,950	27.53	5.67

Compiled from official sources.

In addition to the costs cited, charges for cartage, storage, reconditioning, loss of fruit, etc., must be added. At the time of shipment, the above-mentioned car of pears, according to inspection certificate, showed decay ranging from 3 to 13 percent. Only sound fruit is sold to the trade in Mexico, which means reconditioning every box.

TABLE 30.-*Cost of a car of Delicious apples of 798 boxes shipped from Wenatchee, Washington, to Mexico, D. F.*

ITEM	COST PER CAR		COST PER BOX	
	Pesos	*Dollars*	*Pesos*	*Dollars*
Invoice price	6,965	1,436	8.73	1.80
Freight, Wenatchee to El Paso	1,741	359	2.18	.45
Duties and other expenses	7,207	1,486	9.03	1.86
Freight, Juárez to Mexico, D. F.	1,235	255	1.55	.32
Total	17,148	3,536	21.49	4.43

Compiled from official sources.

Shipments in transit from California to Mexico, D. F., require about 12 days, from Oregon 15 days, and from Washington about 18 days. Apples are usually shipped during the winter months by freight under ventilation; but pears, grapes, and stone fruits move by express in iced cars. Freight in Mexico moves much too slowly for shipping highly perishable products; consequently, importers are forced to pay the higher express charges as a protection against deterioration. Icing facilities are available at Juárez, Torreón, and Aguascalientes. The usual custom is to re-ice the cars at Juárez and again at Torreón or Aguascalientes, depending upon the season and the amount of ice in the bunkers. Four tons are used at each icing, 2 tons in each bunker. Occasionally they are iced twice, using but 2 tons at each icing.

The freight from California points to El Paso is 89 cents per 100 pounds. From Oregon and Washington shipping points it is 95 cents. In Mexico the express rate from Juárez to Mexico, D. F., standard refrigeration, is 130 pesos per ton, but the consignee must pay extra for icing at the rate of 22 pesos per ton. The freight rate between the same points is 54.40 pesos per ton. Express shipments between Juárez and Mexico City require 2 days as against 8 by freight.

Only fruit of the highest quality is imported into Mexico because of the high costs involved. Importers have found no economy in purchasing the lower grades, since the saving in the cost of the fruit is more than offset by the high carrying and entry charges involved. Freight, duty, handling, and other charges are no higher on Extra Fancy goods than on C Grade or U. S. No. 2. Since the laid-down cost of imported fruit is already too high to permit a wide distribution, the quality of the fruit handled must be commensurate with the type of clientele to which the importers cater.

The Mexican market is capable of absorbing only one straight car of apricots, in addition to the small broken-lot shipments that move into the border towns from such markets as El Paso, Laredo, Brownsville, and San Diego.

The trade in cherries amounts to one or two straight cars only. The first is shipped from California and the second, from Oregon. The preferred variety is Bing, but a few Lamberts are sometimes included in a mixed car.

Although Mexico produces quite a volume of plums in certain years, their quality is not considered comparable with the imported product. Domestic plums are small, mostly seedlings, or of unknown parentage, low in sugar content and high in percentage of water. The season for the home-grown Mexican plum begins between April 15 and May 1, and is of short duration. The importing season starts with Santa Rosa plums and finishes with Presidents, which two varieties constitute the bulk of the imports. About 300 crates of Kelseys and 200 crates of Gaviotas are usually sold through importers in Mexico City in addition to the above-mentioned varieties. The demand is restricted to large sizes only, sizes smaller than 4 x 4 are impossible to move. A total of 7 to 9 straight cars are imported during the season.

Mexican peaches are largely seedling types, small, clingstone, and of poor eating quality. Home production, however, seems to take care of domestic requirements; other than the broken-lot shipments that come into the border towns, peaches are not imported into Mexico City in straight cars.

Grapes are the most important of the various kinds of fruit imported and represent about 50 percent of the total. Thompson Seedless, Ribier, and Emperor are the preferred varieties. U. S. Fancy is the preferred grade, although some shipments include a few lugs of U. S. No. 1.

The import trade in pears consists of about 20 cars, starting with Bartlett and finishing with Winter Nelis. The Bartlett, as in many markets, is the best known and therefore the preferred variety, but sales are limited because of its conflict with home-grown supplies. The first cars are scheduled to arrive late in July, before local supplies appear on the market; shipments are resumed when domestic offerings begin to disappear. The principal variety imported is the Anjou, 10 to 12 cars of which arrive each season. About 1 car of Comice and small quantities of Bosc and Winter Nelis make up the remainder. Only the best grades are purchased, and the preferred sizes range from 100's to 135's.

About 35 carloads of apples are purchased annually by Mexico City importers, Red Delicious accounting for more than 65 percent of the total. From 2 to 3 carloads of Winesap, 1 to 2 cars of White Winter Pearmain, and about 2 cars of Golden Delicious are purchased in addition. An additional 25 to 35 cars are brought in in the form of small broken-lot shipments.

The Mexican people, as most Latin Americans, prefer highly colored fruit; hence the red varieties have a distinct preference over green and yellow varieties. A large part of the imports are of Extra Fancy grade, because most retailers will handle nothing else. Apples, which are hardier than most other fruits, are usually shipped by freight in order to reduce their cost. The large sizes are the best sellers, and purchases are usually made on the basis of a 56- to 163-size range broken down in the following proportions: 56's to 100's, 25 percent; 113's to 138's, 50 percent; 150's to 163's, 25 percent. The most popular counts are 100's to 138's, but 72's and 80's also enjoy a good demand.

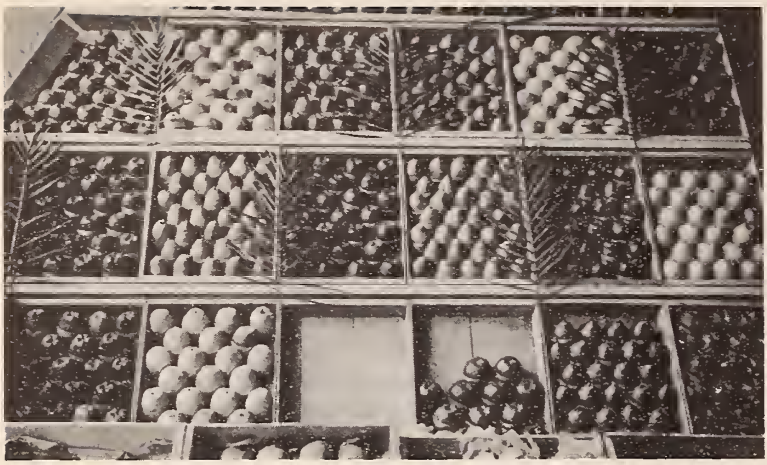


FIGURE 125.-United States apples on display in a Mexican wholesale market.

Selling Prices

Values, both wholesale and retail, are governed by the cost, which, of course, fluctuates from week to week and season to season. Importers claim that, despite their annual turnover and the seemingly high selling prices, there is no large profit in the business. Because of the high cost of delivery, the risks involved, and the frequent slowness and uncertainty of collection, heavy losses are often sustained. Grapes which formerly sold for around 1.65 to 1.80 pesos per kilo (15.4 to 16.8 cents per pound at the 1942 rate of exchange) must be retailed at around 2.00 to 2.50 pesos (18.7 to 23.3 cents per pound) in order to show a profit. At these prices, sales are confined to a limited group, and even so the demand is not active. Frequently, the fruit deteriorates faster than it can be moved, especially in the tropical parts of the country, which means a loss to the retailer. Since shippers began using the sulfur-dioxide treatment as a means of controlling decay, the risks, largely because of condition factors, have been materially reduced. Formerly cars sometimes arrived in such bad condition that they had to be salvaged for any price they would bring, usually at a heavy loss.

Cherries generally cost in the neighborhood of 3.50 pesos per kilo (32.7 cents per pound), delivered to Mexico City. They are sold at 4.00 pesos (37.3 cents) to the trade, who in turn sell them to the public at around 5.00 pesos per kilo (46.7 cents per pound).

Apricots, which cost around 1.65 pesos per kilo (15.4 cents per pound), sell wholesale at 1.75 pesos (16.3 cents) and retail at from 1.85 to 2.00 pesos per kilo (17.3 to 18.7 cents per pound). In case the importer is unable to dispose of them before they begin to break down, they are preserved. Domestically grown and preserved apricots sell for around 40 pesos ($8.23) per case of twenty-four 2½-size cans, whereas the United States product sells for 72 pesos ($14.81). On this basis, imported fruit can be canned if necessary and still make a profit.

Delicious apples, which during March 1942 cost 21.55 pesos ($4.43) per box delivered to Mexico City, were offered to the trade at 25 pesos ($5.14). Winesaps which cost 21.00 pesos ($4.32) per box, were sold at 24.00 ($4.94). These costs are c.i.f. Mexico City and are exclusive of additional charges for unloading, cartage, warehousing or cold storage, reconditioning, repacking, etc.

Pears, which cost around 27.50 to 28.00 pesos ($5.66 to $5.76), are sold from 30.00 to 35.00 pesos ($6.17 to $7.20), depending upon the condition of the fruit and the percentage that is lost in repacking because of decay. Anjou pears, during the 1941-42 shipping season, were of poor keeping quality; since all fruit sold by the importer is guaranteed to be of sound condition, it was necessary to go through every box to see that the fruit was as represented.

A large part of the fruit imported into Mexico is purchased on credit. This arrangement is the outgrowth of an understanding that has developed between buyer and seller and is the result of good faith on the part of contracting parties. Since the business is small, it is confined to a few operators. These shippers are familiar with the requirements of the Mexican market; they, therefore, make an effort to supply those sizes and grades that can be sold to the best advantage. When cars of fruit arrive in poor condition, or the quality is not up to expectation, differences are invariably settled on an amicable basis. In a few cases, the fruit is purchased for cash; in others, against letters of credit, with payments made through the bank upon receipt of the documents.

Business relations between Mexican importers and United States exporters appear to be on a satisfactory basis. Importers seem well satisfied with the quality and condition of United States fruit and the high plane upon which the business is conducted. The only complaint voiced was in connection with the high laid-down cost of the fruit, which restricts sales and distribution.

DISTRIBUTION

Mexico is the second most populous country of Latin America and, as in its sister republics, a large part of its people live in the capital city. According to the 1940 census, the country had a population of over 19,600,000. Its land area covers 760,372 square miles, but the heaviest concentration of people occurs in the central plateau, which contains the greatest percentage of arable land and where climatic conditions are more favorable. Mexico, D. F., is the capital and largest city in the Republic, with a population of about 1,500,000. Next in population is Guadalajara, with 229,000 inhabitants, after which are Monterrey with 186,000, and Puebla with 138,000. Other cities, such as Aguascalientes, Tampico, Torreón, and Veracruz, have from 71,000 to 82,000 inhabitants.

Practically all fruit imported into Mexico by carlots is brought in by three firms, located in Mexico City. One firm handles about 60 percent of the imports, the second about 30 percent, and the third around 10 percent of the total. Cities with a population as large as that of Guadalajara, Monterrey, or Puebla, apparently could handle carlots, but experience has proved otherwise. On the other hand, around 50 percent of the fruit brought in to the capital is sold outside the city. Dealers in the larger cities, such as Guadalajara, Tampico, Puebla, San Luis Potosí, etc., purchase their requirements through importers in Mexico City, whereas those towns and areas within a reasonable truck or rail journey from the frontier make their purchases in the United States cities and towns located along the border. Monterrey, for example, relies upon San Antonio and Laredo for its fresh-fruit requirements, Matamoras draws supplies from Brownsville, and Juárez does its shopping in the El Paso market. All latter imports are largely in the nature of small broken lots and, though difficult to calculate, run into rather substantial figures during the course of a year. Small express shipments from El Paso sometimes penetrate rather deeply into the interior of the country, but, for the most part, the inland towns and cities are served from Mexico City.

In view of the difficulties involved, such as lack of transportation, slow communication, low purchasing power of the people, and the high cost of United States fruit, the problem of distribution is by no means an easy one. These difficulties have, furthermore, resulted in certain customs and trading practices that add to the work and expense but are necessary to maintain distribution. For example, the trade served in the capital area insists upon and receives only sound fruit. If a box of apples shows a numerical count of 138 units, the buyer expects to get 138 sound apples. He goes through the box and counts them. If two or three of the apples show decay, the seller, who is usually the importer, is expected to substitute sound fruit for them. This method of merchandising has led up to the practice of repacking each box of fruit before it is sent out. While it adds to the expense, it eliminates a lot of trouble and saves on collection and delivery. Orders received from customers outside the metropolitan area are treated in the same way. Each box is examined before it is shipped, and the seller guarantees sound condition at the time of shipment. The buyer assumes condition risks between point of origin and destination. Practically all the business in United States fruits is conducted on the basis of small lots and even single packages. Contrary to the practice in most large cities, where sales are made in lots of 10, 20, or more packages, most of the purchases consist of only 1 or 2 boxes. Orders are received by the importers in Mexico City from points as far away as Tapachula, which is on the Guatemala frontier, or from Manzanillo, which is on the South Pacific coast. These orders usually call for 1 box of apples, or a box of pears, or a lug of grapes. On many occasions orders are received by telegraph asking for a box of this and a box of that. One telegram was seen ordering half a box of pears and 1 box of apples. This inland business, while troublesome, is nevertheless appreciated and sought after. To sell a car of grapes, for example, in Mexico City requires about 20 days, but by servicing the cities and small towns within a radius of 500 miles from the capital a car can be cleared in about 8 days. The question of decentralization as a means of effecting a wider distribution has frequently been raised by United States shippers. The practical application of this idea is perhaps not without merit as far as the United States is concerned, but in Mexico conditions are quite different. A common occurrence in small remote Mexican towns is to be approached by a street vendor who offers a United States apple or pear for sale from a tray, hung by a strap from around his neck much as hot dogs, peanuts, crackajack, and candy are sold by the boys at a football or baseball game in the United States.

Even though the fruit is purchased in such small lots, sales are slow, and frequently a part of the supply deteriorates before it is all sold. In most cases, the price is beyond the reach of the native population, and the sales made are to foreigners or to the small minority of local citizenry who can afford to indulge in an occasional luxury.

Under existing conditions the present form of distribution is about as good as can be expected. Other avenues have been explored and were found wanting. The largest importer of United States fruits is operating under a system based upon more than 20 years of experience in the selling and distribution of fruits in Mexico. He lived in the United States for many years and is rated as an intelligent, aggressive, and successful business man and one who overlooks few opportunities.

The possibility, therefore, of developing an important outlet for United States fruit in Mexico is not unlike that in other Latin American countries. Standards of living and purchasing power, compared with those in the United States and certain pre-war European countries, are low. The prospects for doing any appreciable amount of business are not particularly bright. Of the various obstacles to be overcome, the most difficult, from the importer's point of view, is the prevailing high rate of duty. Of the country's total population of nearly 20 million, only a small number of people have sufficient means to pay the price United States fruit must realize.

About 7 percent of the inhabitants of Mexico live in the capital and about 14 percent in cities of more than 50,000. This means that most of the people live on farms, or in small towns and villages. In Mexico City, where most of the wealth of the country is concentrated, not more than 5 percent of the population are estimated to be financially able to purchase United States fruit. Various government employees, for example, who perhaps are as well, if not better, paid than the average worker, frequently say that they would like to purchase United States apples, pears, or grapes but their incomes prevent them from indulging in such extravagance. For cheap low-grade fruit, the outlet would be much broader; but because of duty, high transportation, and other charges, the importation of this class of merchandise is prohibitive.

Fruit is not scarce in Mexico, as it is in many countries. This is especially true of tropical and subtropical fruits. The quality of home-grown deciduous fruit, however, is decidedly inferior when judged by United States standards. The determining factor is the relative cheapness of the domestic product. When the supply of deciduous fruit is exhausted, subtropical fruits are available. This may not always appease the appetite, but it nevertheless provides a suitable substitute in the nature of a fruit diet. Fresh crisp apples or juicy palatable grapes or pears are preferred in any country to shriveled, spent, insipid fruit, regardless of its origin; but if one is cheap and the other a luxury, there is no choice. The consuming public has no prejudice against United States fruit. When the local supply of plums or grapes has been consumed, the public would like to turn to imported supplies. The same holds true for apples and pears during the late winter and spring months. As in any other country, the desire for fresh fruit on the part of the people is clearly apparent, but the proverbial question arises as to how to adjust price to the ability to pay.

Even if the present duty on imported fruit could be reduced to its former level and other costs adjusted in proportion, doubt still remains as to whether the Mexican market would be capable of absorbing an increase of more than 150 to 200 percent above present takings.

Although the Mexican fruit industry has expanded somewhat, the increase has been largely in connection with citrus fruits. Unlike Argentina, Chile, and many other countries, the production of deciduous fruits has not even approached a state of self-sufficiency to say nothing of Mexico's having joined the fraternity of countries producing an exportable surplus. Although the acreage in deciduous fruit is being somewhat expanded, the increase is slight, and no appreciable gain in volume of production is apparent or anticipated.

QUARANTINES

The quarantines issued and in force in Mexico resemble those of the United States rather closely. They are designed to prevent the spread of pests and diseases within the country and to prevent the introduction of new pests or diseases. Those specifically relating to fruits are relatively few in number and constitute a smaller body of reglementation than is applied in some other countries.

To accomplish the purposes of preventing spread or introduction, two types are in force: Domestic and Foreign. Both are of recent origin, but were preceded by earlier regulation. With reference to fruits and fruit plants, four domestic and four foreign quarantines are in effect as follows: Domestic, Nos. 2, 4, 5, and 6; Foreign, Nos. 1, 5, 7, and 10.

Within the country domestic quarantines were established to protect northwest Mexico from spread of the Mexican fruitfly (*Anastrepha* sp.), to control citrus red scale in Sonora, and against the Panama disease of bananas. Foreign quarantines are in effect against citrus diseases and pests including citrus canker, orange blackfly, and citrus rootworm (*Tylenchulus semipenetrans* Cobb); against possible introduction of the Mediterranean fruitfly, by an absolute quarantine on all imports of fruit with a tender pericarp from infested countries; a quarantine on all banana plants from Panama and sigatoka diseases. The last foreign quarantine is to prevent the entry into Mexico of certain stone-fruit diseases. These are found in the United States and include the phony peach disease, peach yellows, peach rosette, and little peach.

Regulations of the quarantines are applied, control measures carried out, and inspections made by a staff of government officers working as a division of the *Dirección General de Agricultura*. They are trained officials and strategically located throughout the country. Some outstanding examples of work are to be found, notably that of controlling pink bollworm of cotton. For fruit, the control of pests and diseases, apart from enforcing quarantines, is rather minor in nature. This is quite understandable, since the Government's efforts cannot move far ahead of public demand and consciousness. Extension work and education are rather limited in Mexico, and the field of the entomologist and pathologist is thus restricted.

THE UNITED STATES AS A MARKET FOR MEXICAN FRUIT

Mexico produces a large variety of fruits, many of which are unknown to inhabitants living in the Temperate Zone. In the tropical and subtropical region such fruits as the papaya, mango, cherimoya, sapote, avocado, mamey, and granadilla are produced in abundance and are as familiar to the people as are apples and pears to those living in the north. Most of these exotic fruits are naturally looked upon in the United States as a luxury, and in a sense they are; but in the regions to which they are indigenous they form an important part of the poor man's diet. In season these fruits are distributed over a large part of Mexico and are priced so as to reach a wide class of people. Many of these fruits, in fact, grow more or less wild and even when cultivated receive the minimum of care.

Bananas and pineapples, on the other hand, which need no introduction to a Temperate Zone dweller, are cultivated and receive much the same care as would be given them by a truck grower or orchardist in the United States.

Certain tropical fruits are attacked by and act as hosts to the fruitfly and other injurious insects that so far have not spread to the United States. As a safeguard against their introduction, drastic measures have been adopted. One of the measures is a quarantine law, which prohibits the entry of those fruits which are known to be hosts to these insects. Among the fruits so restricted are the sapote, mango, cherimoya, guava, and orange, but the banana, pineapple, lime, papaya, and avocado are allowed to enter after complying with certain quarantine regulations.

The commercial importation of pineapples, bananas, papayas, and limes is authorized, under permit, to enter at all ports, but the avocado is restricted to the North Atlantic and North Pacific ports of entry and must be one of the thick rough-skinned West Indian or Guatemalan hybrids.

Of the various fruits produced in Mexico, which are allowed to enter the United States, the papaya is the least known.

Other exotic fruits that have merit, but which are now prohibited in the United States, may sometime be permitted to enter if means can be found to avoid endangering

TABLE 31.-*Mexican import duties on specified fresh fruits, 1929-43*

FRUIT AND PERIOD	RATES IN FOREIGN UNITS: IMPORT DUTY	RATES IN FOREIGN UNITS: SURTAX	U. S. CURRENCY[1] (INCLUDING SURTAX)
	Pesos per kilo	*Percent of duty*	*Cents per pound*
Apples:			
1929	0.06	13	1.48
1930: Jan. 1	.10	2	2.18
Nov. 14	.35	2	7.63
1931	.35	3	5.80
1932	.35	3	5.21
1933: Jan. 24	.10	3	1.31
Apr. 1	.35	3	4.60
1934	.35	3	4.54
1935	.35	3	4.54
1936	.35	3	4.54
1937	.35	3	4.54
1938	.35	3	3.62
1939	.35	3	3.16
1940	.35	3	3.03
1941	.35	3	3.36
1942	.35	3	3.36
1943 (Jan. 30)[2]	.30	3	2.88
Pears:			
1929	.06	13	1.48
1930: Jan. 1	.10	2	2.18
Nov. 14	.35	2	7.63
1931	.35	3	5.80
1932	.35	3	5.21
1933: Jan. 24	.15	3	1.97
Apr. 1	.35	3	4.60
1934	.35	3	4.54
1935	.35	3	4.54
1936	.35	3	4.54
1937	.35	3	4.54
1938	.35	3	3.62
1939	.35	3	3.16
1940	.35	3	3.03
1941	.35	3	3.36
1942	.35	3	3.36
1943 (Jan. 30)[2]	.25	3	2.40
Peaches:[3]			
1929	0.06	13	1.48
1930: Jan. 1	.10	2	2.18
Nov. 14	.35	2	7.63
1931	.35	3	5.80
1932	.35	3	5.21
1933	.35	3	4.60
1934	.35	3	4.54
1935	.35	3	4.54
1936	.35	3	4.54
1937	.35	3	4.54
1938	.35	3	3.62
1939	.35	3	3.16
1940	.35	3	3.03
1941	.35	3	3.36
1942	.35	3	3.36
1943 (Jan. 30)[2]	.25	3	2.40
Oranges and lemons:			
1929	.06	13	1.48
1930: Jan. 1	.10	2	2.18
Nov. 14	.35	2	7.63
1931	.35	3	5.80
1932	.35	3	5.21
1933	.35	3	4.60
1934	.35	3	4.54
1935	.35	3	4.54
1936	.35	3	4.54
1937	.35	3	4.54
1938	.35	3	3.62
1939	.35	3	3.16
1940	.35	3	3.03
1941	.35	3	3.36
1942	.35	3	3.36
1943	.35	3	3.36

[1] Conversions into United States currency made at average annual exchange, except for 1943 when average for the 3 months ending with March was used.

[2] Duty reduced under trade agreement between the United States and Mexico, effective January 30, 1943.

[3] Same duties apply to apricots, plums, and grapes; also fresh fruit, not specified, which covers cherries and grapefruit.

Compiled from official sources.

the future of the United States fruit industry because of the presence of pests. A few of these fruits have been discussed in some detail under the section dealing with tropical fruits.

Under present conditions, limes, bananas, and pineapples are the most promising fruits produced in Mexico for marketing in the United States. Bananas are the most important, followed by pineapples and limes. Bananas are imported duty-free and, for the past few years, have averaged around 10 million bunches annually. Because of the war, distribution has been seriously disrupted. Transportation by water has been almost entirely eliminated, throwing the entire burden upon the railroads.

Under normal conditions bananas receive a fairly wide distribution, but, because of limited supply, this has been reduced to a rather narrow range, or to the territory largely contiguous to the points of entry. The scarcity of supplies from other producing areas has resulted in an unusual demand for the Mexican product. Since a large part of Mexico's export bananas originate along the east coast and in the States of Veracruz and Tabasco, they follow the eastern lines of communication and enter the United States largely through Laredo, Brownsville, and other Texas points of entry.

The Loma Bonita, Isla, Sarabia, and Mogoñe districts produce from 80 to 85 percent of the pineapples imported into the United States, the bulk of which enter at Laredo. The shipping season begins in April with the Sugar Loaf and Smooth Cayenne from Sarabia and Mogoñe. Practically all shipping is over by July 20. The peak movement extends from the latter part of May through June, a period of about 5 weeks.

The Sugar Loaf, which is produced in very small quantities, starts to move about the middle of April and about one month later Isla, Veracruz, and Loma Bonita, Oaxaca, start exporting Smooth Cayenne, the only variety moved from these points. Mexican pineapples are large, many of them weighing upward of 10-12 pounds. The very large specimens, however, are not exported, the size being undesirable for family use. The average shipping weight of the Esmeralda is 6 pounds; the Sugar Loaf, 6 pounds; the Smooth Cayenne, 5 pounds.

The fruit at the loading point is nested in boxcars, and during the peak movement cattle cars are sometimes employed. Most of the pineapples move over the wide-gage railway to Córdoba and are hauled over the Mexicano system from this point to Mexico City. Generally no reloading takes place at Mexico City; the same cars move straight through to the border. A few go forward in refrigerator cars, but to get reefers is almost impossible, and furthermore the costs are much higher. Mexican railways charge 25 percent additional for hauling refrigerator cars and 5 centavos per kilometer (1.7 cents per mile) additional for moving empties.

The fruit is shipped loose, that is, nested in the car. An earlier attempt to pack the fruit in crates was discontinued; first, because of the size of the individual fruits, and second, because the added weight increased the cost of transportation and duties. The cars contain on an average of 5,500 fruits weighing 14 to 15 tons. The freight rate is based upon a minimum weight of 12,500 kilos, or 28,000 pounds. The freight to Laredo amounts to 31.41 pesos per metric ton. If shipped under refrigeration, 25 percent is added. The c.i.f. value at Laredo works out at around $21.00 per ton, including the cost of the fruit:

12,500-kilo cars at $13.00 per metric ton . . .	$162.50
Freight	105.52
Aforo - export tax, 12 percent[1]	9.00
Switching charge	9.44
Customs brokerage	14.50
Duty, U. S.	49.50
Charges, Nuevo Laredo	4.50
Charges, Laredo	4.50
Total	$359.46

[1] Aforo changes every 3 months.

The average cost of pineapples in 1941 was 45 pesos per metric ton (about $8.40 per short ton); in 1942, about 55 pesos; and in 1943 still higher. The season usually starts off with high prices that decline as supplies increase.

The condition of the fruit upon arrival at Laredo is generally good. It must be handled rapidly, however, on arrival. It usually moves out within 5 days but, in any event, must be cleared within 8 days after arrival. Fruit that is overripe and will not withstand reshipment is sent to the canner.

From Laredo most of the fruit is redistributed by trucks, which cover the States of Texas and Oklahoma. Some are shipped to Colorado, New Mexico, Arkansas, Louisiana, Tennessee, Nebraska, Iowa, Kansas, and Missouri. A larger area could be covered, possibly all the Central States, if shipments could reach these areas within 5 days after leaving Laredo. About 95 percent of the shipments out of Laredo are moved by truck. Those shipped by rail are loaded loose in refrigerator cars. Because of the tire shortage, rail shipments are expected to increase. Around 400 cars are imported through Laredo; 50 to 75 through El Paso; and 75 to 150 cars, or an average of 100, through Brownsville (used for canning). The pineapples are sold by the dozen by importers. The range is from 90 cents to $1.30 per dozen, but most of them bring $1.30. At around $1.00 per dozen, they can be moved rapidly and in volume. In San Antonio they wholesale at from $1.50 to $1.85 per dozen. The retail price is usually around 20 to 25 cents each. Since they are large fruit, the retail price works out at about 4 or 5 cents per pound. Most of the sales are made to chain stores and are used largely for week-end loss leaders. They are purchased mostly for canning purposes. Mexican pineapples are well received in the United States markets. In addition to their large size, they are attractive in appearance and have a high sugar content. With the advent of industry organization, improved handling, and better transportation methods, the United States markets should offer increased opportunities for this fruit.

Imports of limes from Mexico show considerable fluctuation, from one season to another, and marketing possibilities have been restricted to a rather small area. Their distribution has been more or less limited to the Pacific-coast area, the Southern States, and the Middle Western States. Imports entering the border towns of El Paso, Douglas, and Nogales invariably move westward to the cities along the Pacific coast. Those entering Laredo, Texas, which is the most important point of entry, are distributed largely to the markets in the South and the Middle West. Occasionally shipments are made to markets along the Atlantic seaboard but only to supplement supplies regularly imported from the Caribbean area.

Distribution is made by both truck and rail. For Texas and its neighboring States a large part of the limes are sent out by truck, but for the more distant markets, shipment is by rail.

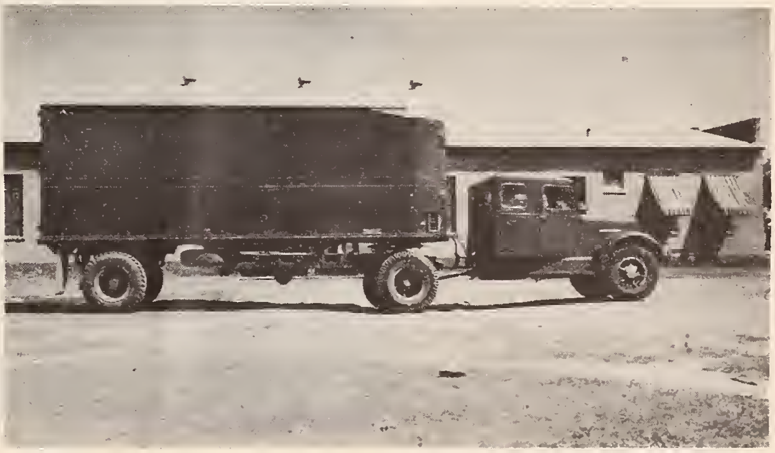


FIGURE 126.-Large trucks used for distributing Mexican limes.

Before Mexico can take full advantage of the opportunities offered by the United States market, some rather drastic changes must take place on the home front. The producer in Mexico under normal conditions has received comparatively little for his product, considering the prices paid by the consumer. Consumer prices, on the other hand, have not been excessive when transportation costs are taken into account. The producer, for example, in 1941 received from 6 to 8 centavos per kilo - about 0.33 centavos each - or about 50 cents in United States currency for a box of 750 limes. By the time this box of limes reached a United States border town it represented an investment of around $2.63. The limes were then regraded, processed, and repacked into other containers before being reshipped, or distributed, from this border town to markets within the United States. These operations, including losses from rejected or decayed fruit, added another dollar or more to the cost. Transportation, handling charges, selling commissions then took an additional toll, and altogether Mexican limes became rather expensive by the time they reached the United States consumer. In fact, the greater part of the cost of limes to the consumer in the United States may be attributed to spoilage and charges for transportation, repacking, and distribution.

In the eastern markets limes from the Antilles, or Caribbean area, are preferred to the Mexican product; first, because they are cheaper, and second, because they are in better condition, and third, because they are more mature and have a higher juice content.

The discrimination against Mexican limes at a cosmopolitan market, such as New York, is not due to natural causes. Nature has more than contributed her share toward producing a product of quality. The principal drawback to the fruit is the way in which it is handled. Growing a product capable of withstanding competition in any market is admittedly essential, but to be able to grow a good product only to find that it cannot be marketed is of little consolation to a grower. The first and greatest problem is transportation, especially in the producing country. The improvement of Mexico's roads, particularly those between areas of production and the railhead, or center of distribution, is of primary importance. This could be accomplished in many instances at a minimum of expense. More careful handling in the picking, grading, packing, and shipping would permit the marketing of fruits of more advanced maturity and ensure more satisfactory results at the border. These improvements in turn would mean a cheaper product, satisfied customers, and a wider distribution.

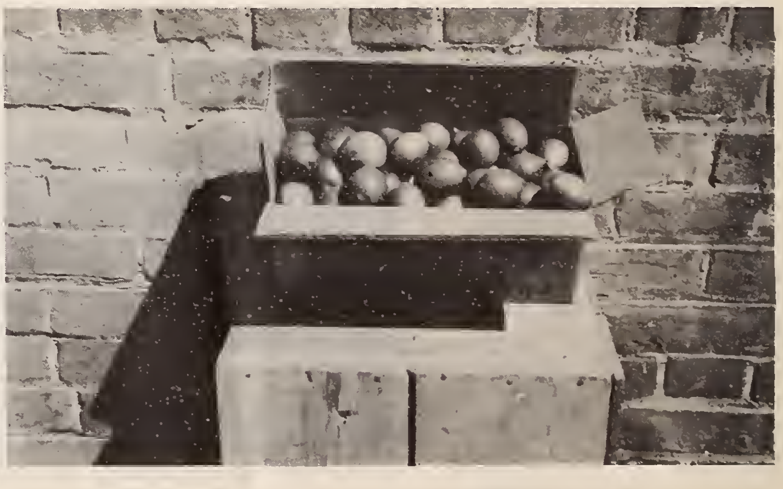


FIGURE 127.-Limes packed in 10-pound boxes.

To ensure maximum distribution, importers at the border towns, such as Laredo, spare neither expense nor energy. For example, when a box of limes arrives in the United States, the fruit is first removed from its original shipping container and put through a washing bath, which both cleans and disinfects it. The limes are then passed over the grading belts, where they are carefully examined and defective fruits removed. They are then brogdexed, or given a wax coating, which preserves the fruit and increases its marketing life. After this treatment, it is separated according to size and wrapped and packed into containers, which vary in size depending upon the needs of the different markets. Some are packed loose in attractive fiberboard boxes holding 10 pounds, net weight of fruit. Others are packed in small cartons, with cellophane windows, 12 limes to a carton. These cartons are then placed in fiberboard containers holding 12 cartons. The smaller limes are packed in cellophane bags holding from 8 or 9 up to 15 or 18 limes, and the bags are then packed in a shipping carton that holds 36 small bags. Others are packed in wooden boxes, holding 45 pounds, net weight, of fruit, ranging in count from 400 to 1,000, depending upon size.

By using these different types of containers, the distributors have made an effort to cater to the requirements of all classes of trade; in fact to meet each individual need. Hotels, restaurants, and other businesses that use large quantities of limes can buy them in 45-pound boxes. Drug stores and bars that serve one small lime to a drink can buy them by the bag. For household use, the small carton is available.

Mexican limes, if they are to compete with West Indian limes on Atlantic-seaboard markets, must first of all be competitive in price, but as matters now stand, the latter can be laid down at New York much more cheaply than the Mexican product. West Indian limes are shipped in barrels weighing from 175 to 185 pounds net. They are individually wrapped and packed in layers. The contain from 850 to 2,800 units, depending on size. The average range is from 1,200 to 2,200. Limes from the Dominican Republic are usually packed in three sizes; the smallest size averages around 1,800 to the barrel; the medium, 1,450 to 1,500; and the large, 1,100 to 1,200. The grading is done at the place of origin, and no effort is made to regrade and repackage the fruit as is done by the distributors of Mexican limes. Only first-grade limes are shipped; the lower grades are processed, being used largely in the manufacture of lime juice and citric acid. Shipment is made by ordinary stowage, and the fruit frequently arrives full of heat. Its condition, however, upon arrival is generally good. Trading is conducted almost entirely on the basis of outright purchase, with quotations made at a stipulated price, f.o.b. port of export. Prices fluctuate from $6 to $12 per barrel, according to supply and season, but the average purchase price is around $8 to $8.50 per barrel. Freight charges from West Indian ports to New York amount

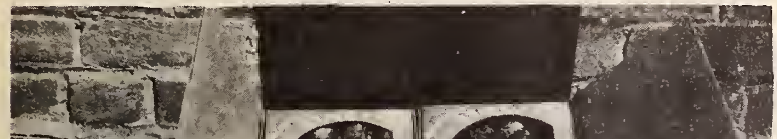


FIGURE 128.-Mexican limes packed in small cartons.

to $1.28 per barrel. The fruit is sold, ex pier, on the basis of 100 units. New York handlers state that Mexican limes are difficult to sell in competition with the Florida or West Indian product and the trade will turn to the former only when the latter are scarce or unavailable. The retailer is interested in green limes only, and Mexican limes by the time they reach New York are said to be too advanced in color.

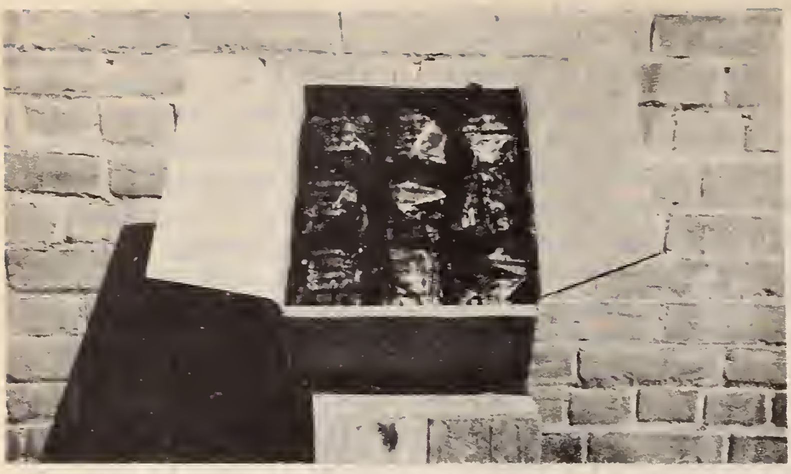


FIGURE 129.-Limes packed in cellophane bags.

Because of the scarcity of limes in 1942, due to shipping difficulties, prices increased sharply. West Indian limes that ordinarily cost around $7 to $8 per barrel were quoted at $11, f.o.b. Mexican limes that sold for 5 pesos ($1.03) per box in 1941 cost 18 pesos ($3.70) in March 1942, with shippers asking 22 ($4.53) for April delivery.

The shipping costs of Mexican Limes on the dates specified were as follows:

	Mexican pesos	*United States dollars*
August 1941:		
15 boxes export limes at 5 pesos	75.00	15.46
Express - 15 boxes at 1.60 per box	24.00	4.95
Mexican export tax -		
15 boxes at 30 kilos each, 450 kilos		
450 kilos at 31¢ fixed value, 139.50		
139.50 at 12 percent tax	16.74	3.45
Mexican customs broker - 15 boxes at 50¢ each	7.50	1.55
Total	123.24	25.41
American duties - 870 pounds at 1½¢ per pound		12.05
Duty on boxes - 15 at 10¢, $1.50 at 25 percent		.38
Drayage - 15 boxes at 4¢ per box		.60
American customs broker (minimum charge)		1.00
Total cost of 15 boxes		39.44
Total cost per box		2.63
March 1942:		
42 boxes at 18 pesos	756.00	155.88
Express	67.20	13.86
Export taxes, etc.	20.91	4.31
Customs brokerage	21.00	4.33
Total	865.11	178.38
American duties - 2,730 pounds at 1½¢		40.95
Duty on boxes - 42 at 10¢, $4.20 at 25 percent		1.05
Drayage - 42 boxes at 4¢ per box		1.68
American customs brokerage		1.00
Total cost of 42 boxes		233.06
Total cost per box		5.31

When the Prohibition Act was in effect in the United States, the demand for limes was confined to the summer months, May 1 to September 30; but since the repeal of this act the demand has spread throughout the year. Formerly, limes were used in the form of cooling drinks, principally limeade; but they have since become popular as a base for mixing cocktails.

Although the Mexicans claim that exports of limes to the United States have declined because of a falling off in demand, United States importers of Mexican products report that efforts made on their behalf to increase trade between the two countries are invariably offset by the imposition of export taxes levied by the Mexican Government upon shipments crossing the border. The original purpose of the export tax, or *aforo*, was to enable the Mexican Government to absorb a certain percentage of the profits realized by exporters as a result of the depreciation of Mexican currency in 1938, and since that time taxes have been levied primarily for revenue purposes.

Since the first of January 1925, limes have been exempt from export duties under classification No. 76. When the decimal tariff of 1939 was established, classification No. 24-13 was assigned to the lime, and it has continued to this date to be exempt from the payment of tariff duties. Because, however, of the drop in the rate of exchange of the Mexican peso, the system of appraisals and export subsidies was adopted in August 1938, and export limes were made subject to the payment of a tax of 12 percent of the appraisal values determined by the Committee of Appraisals and Export Subsidies, on the basis of quotations on the New York market, after deducting the total costs of transportation.

The importer, however, contends that whenever the volume of a commodity increases, export duties are applied or increased in proportion to the volume movement. For example, the export tax on limes from February 21 to March 21, 1942, was 22 centavos per kilo, or about 2 cents per pound. On March 22, and effective for the following monthly period, March 22 to April 22, the tax was increased to 33 centavos per kilo, or about 3 cents per pound, a rise of 50 percent. Further increases went into effect totaling at the end of the season an increase of about 200 percent. This constant change in the export tax, together with the uncertainty that accompanies it, has tended to discourage private trade, since importers claim that under the present arrangement they are unable to plan or anticipate their purchasing program on a seasonal basis but are forced to operate from month to month in conformity with the latest aforo or export tax.

Aforo valuations have been placed on pineapples and bananas as well, but nearly all other fruits, which do not amount to anything commercially, are exported without aforo valuations.

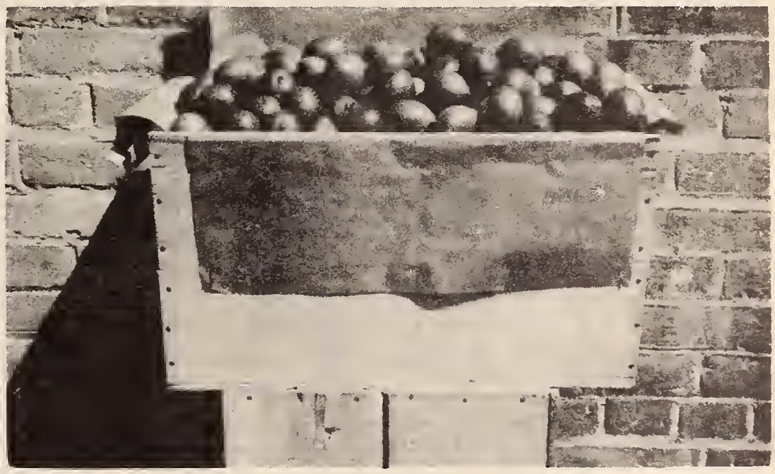


FIGURE 130.-Mexican limes packed in 45-pound boxes.

In comparing the seasonal movement of limes with the imposition of the export tax, increases or decreases seem to be made in direct relation to the volume shipped. This was especially true during the years 1939 and 1942. Bananas move on a fairly uniform basis, being shipped during every month of the year. Pineapples, however, are seasonal, but the aforo valuations for both these fruits have remained quite constant. (See table 32.)

Since Mexican limes are sold on the United States market in competition with the Florida and West Indies product, prices must be on a competitive basis if they are expected to maintain their position in an open market. If West Indian limes can be offered more cheaply in the eastern markets than those from Mexico, naturally the former product will have the preference.

Because changes in aforo, or tax valuation, are effective on the 21st of each month and are not known in advance, speculation on the part of the importer is discouraged, and he does not contract supplies more than a month in advance. Contracting on a seasonal basis is a common occurrence, but when approximate costs cannot be reckoned with some degree of certainty, the hazard is such as to discourage trading.

TABLE 32.-*Changes*[1] *in aforo valuation of limes and pineapples effective from August 10, 1938, to March 20, 1943*

MONTH	1938	1939	1940	1941	1942	1943
	Centavos per kilogram	*Centavos per kilogram*	*Centavos per kilogram*	*Centavos per kilogram*	*Centavos per kilogram*	*Centavos per kilogram*
LIMES:						
January . . .	-	17	30	31	33	46
February . . .	-	17	40	31	33	[2]56
March	-	22	40	31	47	-
April	-	24	45	31	47	-
May	-	24	41	31	67	-
June	-	24	31	22	67	-
July	-	27	15	22	63	-
August	[3]15	22	22	22	63	-
September . .	20	22	22	22	52	-
October . . .	20	18	22	22	52	-
November . . .	20	17	22	33	46	-
December . . .	20	25	31	33	46	-
	Pesos per metric ton	*Pesos per metric ton*	*Pesos per metric ton*	*Pesos per metric ton*	*Pesos per metric ton*	*Pesos per metric ton*
PINEAPPLES:						
January . . .	-	70	18	18	30	30
February . . .	-	70	18	18	30	[2]30
March	-	70	18	18	30	-
April	-	70	42	18	30	-
May	-	18	18	30	30	-
June	-	18	18	30	30	-
July	-	18	18	30	30	-
August	[3]70	18	18	30	30	-
September . .	70	18	18	30	30	-
October . . .	70	18	18	30	30	-
November . . .	70	18	18	30	30	-
December . . .	70	18	18	30	30	-

[1] Changes are effective on the 21st of each month. The figures shown for each month are those beginning on the 21st of that month and continuing until the 20th of the next month.

[2] Effective to March 20, 1943.

[3] Effective from August 10.

RESTRICTIONS ON UNITED STATES IMPORTS OF MEXICAN FRUITS AND VEGETABLES

The general public meets with the administration of quarantines most commonly as a result of the impulse to bring things home from a trip. The traveler, returning to the home port laden with shrubs, fruits, and plants he has accumulated and tenderly cared for along the route of travel, discovers that the Government is standing guard to bar the entry of plants and plant products which may be the means of introducing injurious insects and plant diseases. Frequently he is disappointed. Sometimes he does not understand, and up blazes a feeling of indignation against quarantine laws and regulations in general.

Fruit growers and others engaged in the growing of crops, however, are experienced in such things and need not be reminded of the necessity for unrelenting vigilance against the danger of crop infestations from carried pests. Those interested or engaged in international trade are especially mindful of how imperative it is to see that their products are free from the presence of dangerous pests and diseases.

It is easy for those who are unfamiliar with pest control problems to yield to the notion that quarantines are a subterfuge by which trade and the movement of goods may be interfered with for someone's selfish advantage.

From the beginning, however, the United States Government has approached the subject of quarantines and has administered its regulations solely from the standpoint of biological expediency. The purpose is not to bar the movement of the various plants and products, as such, but to prevent the entry of the carried pests that would spread harm and destruction if allowed to enter. This principle has been recognized by many countries for many years. When the imposition of a quarantine is motivated by political or economic reasons, the only real justification of such measures is frustrated.

The United States placed its first quarantine regulations in force in 1912, and the introduction of fruits and vegetables from other countries was brought under regulation in 1923. To facilitate trade - and to expedite the journey of the traveler with his prized specimens - competent officials are provided at the entry points to make the necessary inspections or to assist in the elimination of the danger by such means as fumigation. The regulations provide that application may be made for entry by permit. This is not a means of hindering or obstructing trade, but on the contrary is a positive measure for facilitating the movement of goods across the border.

The Bureau of Entomology and Plant Quarantine is interested in the practical solution of the question of how to expedite safely the exchange of commodities between countries. The entry of grapes under prescribed conditions and the friendly cooperative understanding between members of the Bureau and their opposite numbers in neighboring countries are striking examples.

For the most part the entry of fruits and vegetables from all countries, including Mexico, is governed by the provisions of the Fruit and Vegetable Quarantine No. 56; the outstanding exceptions are potatoes and sweetpotatoes. The former are admitted from certain countries under prescribed conditions, and the latter from all countries are excluded.

In practice the person contemplating importation applies to the Bureau of Entomology and Plant Quarantine, preferably in advance of the proposed shipment, for a permit - indicating the country or locality of origin of the fruit or vegetable he desires to import, the port of first arrival, and the name and address of the importers in the United States. Upon approval of the application, permits are issued in quadruplicate - one copy is furnished to the applicant for presentation to the Customs officer at the port of first arrival, one copy is mailed to the Collector of Customs, and one is sent to the inspector of the Bureau of Entomology and Plant Quarantine at the port of first arrival. Unless otherwise stated in the permit, all permits are valid from date of issuance until revoked.

When the fruits or vegetables reach the port of first arrival,[6] the importer or his agent submits a notice (in duplicate) to the Secretary of Agriculture through the Collector of Customs, after which the products are examined by a plant-quarantine inspector of the Bureau of Entomology and Plant Quarantine. Permits are recognized at all ports where inspectors of the Bureau of Entomology and Plant Quarantine are located, authorizing the entry – subject to inspection – of the following Mexican fruits and vegetables under the conditions prescribed in the permits:

ALL PORTS:[7] *Allium* spp. (includes chive, garlic, leek, onion, scallion, shallot), artichoke (Jerusalem), asparagus, ayale, banana, bean (lima, string, black-eyed or cowpea), bellflower, *Brassica oleracea* (includes broccoli, brussels sprouts, cabbage, cauliflower, collard, kale, kohlrabi, Savoy), *Brassica pekinensis*, cacao bean pod, carrot, cassava, cactus leaves for candy making, celery, *Cichorium* spp. (includes chicory, endive, escarole, or witloof), chickpea, cucumber, dasheen, durian, eggplant, gingerroot, ginseng, horseradish, *Lagenaria* sp., lemon, lettuce, sour lime, melon, mint, mustard greens, nopal, origano, papaya, parsnip, pea, pepper, pineapple, pitahaya, pricklypear, rhubarb, sage, salsify, spinach, squash (from Baja California only), tamarind bean pod, tomato, waterchestnut, water cress, waterlily root, watermelon, yam bean (pod and root).[8]

MEXICAN BORDER: Balsamapple, bean (faba), beet (including Swiss chard), berry (black, dew, and logan for local consumption, chayote, clover (sweet white), coriander, grape, husk tomato, lambsquarters, olive, parsley, potato (in accordance with Amendment No. 5 of the Potato Regulations, from the Northern Territory of Baja California through Calexico and San Ysidro, California; from Sonora through Douglas, Naco, and Nogales, Arizona; from Chiapas, Guanajuate, Jalisco, Queretaro, and San Luis Potosí, through Douglas, Naco, and Nogales, Arizona, and Brownsville, Laredo, Eagle Pass, and El Paso, Texas), pumpkin, purslane, radish, roselle, squash, strawberry, turnip.

NORTH ATLANTIC: Avocado,[9] beet (including Swiss chard), bean (faba), chayote, parsley, pumpkin, purslane, radish, roselle, squash, strawberry, turnip.

SOUTH ATLANTIC AND GULF: Bean (faba), beet (including Swiss chard), chayote, radish, squash, strawberry, turnip, pumpkin.

NORTH PACIFIC: Avocado.[9]

CALEXICO AND SAN YSIDRO, CALIFORNIA, ONLY: Okra from the Imperial Valley of Baja California, Mexico, only.

---

[6] All fruits and vegetables are subject, as a condition of entry, to such inspection and disinfection, or both, at the port of first arrival as shall be required by the inspector of the Department of Agriculture.

[7] "Ports" as used in this list mean those ports at which this Bureau maintains inspection service in the enforcement of foreign-plant quarantines. "North Atlantic Ports" are the ports of Baltimore, Philadelphia, New York, Providence, and Boston. "North Pacific Ports" are the ports of Portland, Oregon, and Seattle, Washington.

[8] Provision also exists for the movement, in customs bond, and under prescribed conditions, of (1) oranges from any Mexican State and (2) grapefruit from Sonora through the United States to Canada.

[9] Avocados as referred to under North Atlantic and North Pacific ports shall be understood to be the thick, rough-skinned avocados of the West Indian and Guatemalan races and hybrids only. While the commercial entry of avocados under permit at Mexican border ports is not authorized, permission has been made for the entry of small lots of avocados, both thin- and rough-skinned, with the seed removed for local consumption.

TABLE 33.-*United States import duties on specified fresh fruits and vegetables, 1922-42*[1]

PRODUCT	TARIFF ACT OF 1922	RATES OF DUTY[1]		UNDER TRADE AGREEMENTS
		TARIFF ACT OF 1930	BY PRESIDENTIAL PROCLAMATION	
Fresh fruits:				
Bananas	Free	Free	–	[2]Free
Limes	1¢ per lb.	2¢ per lb.	–	[3]1¢ per lb.
Watermelons	35% ad val.	35% ad val.	–	[4]20% ad val.
Cantaloups	35% ad val.	35% ad val.	–	–
Pineapples -				
In bulk	¾¢ each	1-1/6¢ each	–	[5]8/10¢ each
In crates	22½¢ per crate of 1.96 cu. ft.	50¢ per crate of 2.45 cu. ft.	–	[6]35¢ per crate of 2.45 cu. ft.
Fresh vegetables:				
Beans, green or unripe .	½¢ per lb.	3½¢ per lb.	–	[4]2¢ per lb.
Tomatoes in their natural state	½¢ per lb.	3¢ per lb.	–	[4]1½¢ per lb.
Peas, green or unripe .	1¢ per lb.	3¢ per lb.	3.9¢ per lb.	[7]2¢ per lb.
Peppers in their natural state	25% ad val.	3¢ per lb.	2½¢ per lb.	[4]1½¢ per lb.
Eggplants in their natural state - . . .	25% ad val.	3¢ per lb.	1½¢ per lb.	–
Dec. 1 to March 31 . .	–	–	–	[8]1-1/5¢ per lb.
April 1 to Nov. 30 . .	–	–	–	1½¢ per lb.
Garlic	2¢ per lb.	1½¢ per lb.	–	[4]¾¢ per lb.
Onions	[9]1½¢ per lb.	2½¢ per lb.	–	–

[1] These rates do not apply to imports from Cuba, which receive preferential treatment.

[2] Duty-free status bound under trade agreements with Haiti, Honduras, Colombia, etc.

[3] Duty reduced to 1½¢ per pound under trade agreement with the United Kingdom and to 1¢ per pound under trade agreement with Mexico.

[4] Duty reduced under trade agreement with Mexico.

[5] Duty reduced to 9/10¢ each under trade agreement with Haiti and subsequently bound against increase in agreements with Honduras, Guatemala, and Costa Rica; duty reduced to 8/10¢ each under trade agreement with Mexico.

[6] Duty reduced under agreement with Haiti and subsequently bound against increase in agreements with Honduras, Guatemala, Costa Rica, United Kingdom, and Mexico.

[7] Duty reduced to 2¢ per pound in trade agreements with Canada, when imported and entered for consumption during the period from July 1 to September 30, inclusive, in any year, and subsequently reduced to 2¢ per pound the entire year under trade agreement with Mexico.

[8] Duty reduced to 1-1/5¢ per pound, December 1 to March 31, under trade agreement with Mexico; rate is 1½¢ per pound at other times.

[9] Originally 1¢ per pound under 1922 Act. Raised by Presidential proclamation effective January 21, 1929.

Compiled from official sources.

LITERATURE CITED

(1) DIAZ DEL CASTILLO, CAPTAIN BERNAL.
1568. THE TRUE HISTORY OF THE CONQUEST OF MEXICO. (Translated from the original Spanish by Maurice Keatinge. 515 pp. London. 1800.)

(2) Havard, V.
1895. FOOD PLANTS OF THE NORTH AMERICAN INDIANS. Torrey Bot. Club Bul. 22: 98-123. Lancaster, Pa.

(3) Humbolt, Baron Alexander von.
1827. ENSAYO POLÍTICO SOBRE EL REINO DE LA NUEVA ESPAÑA. Vol. 2, 467 pp., illus. (Traducido al español por Don Vicente González Arnao. 5 vols. Casa de Rosa, Paris.)

(4) Popenoe, Wilson.
1934. MANUAL OF TROPICAL AND SUBTROPICAL FRUITS. 374 pp., illus. New York.

(5) Reynolds, Philip Keep.
1927. THE BANANA; ITS HISTORY, CULTIVATION AND PLACE AMONG STAPLE FOODS. 181 pp., illus. Boston and New York.

(6) Simpson, Lesley Byrd.
1941. MANY MEXICOS. 336 pp. New York.

(7) Standley, Paul C.
1922. TREES AND SHRUBS OF MEXICO. U. S. Natl. Mus., Contrib. U. S. Natl. Herbarium. v. 23, No. 2, 171-515; No. 3, 517-848.

U. S. GOVERNMENT PRINTING OFFICE : 1944